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COMMUNICATIONS

Of The Association For

COMPUTING MACHINERY

Volume 1 . Number 7 July 1958

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Published by the Association for Computing Machinery

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COMMUNICATIONS OF THE

ASSOCIATION FOR COMPUTING MACHINERY

Editor-in-Chief
ALAN J. PERLIS
Computation Center
Carnegie Institute of Technology
Pittsburgh 13, Pennsylvania

News and Notices
WALTER F. BAUER
Computation and Data Reduction Center
Space Technology Laboratories
P. O. Box 45564, Airport Station
Los Angeles 45, California

Standards
GRACE M. HOPPER
Remington Rand Univac Division
Sperry Rand Corp.
19th and Allegheny Avenue
Philadelphia 40, Pennsylvania

Managing Editor
SAUL ROSEN
Philco Corporation
Government and Industrial Div.
4700 Wissahickon Avenue
Philadelphia 44, Pennsylvania

Techniques
ROBERT W. BEMER
World Headquarters
International Business Machines Corp.
590 Madison Avenue
New York, New York

Unusual Applications
ARTHUR WOUK
Electronic Systems Division
Sylvania Electric Products, Inc.
100 First Avenue
Waltham, Massachusetts

COMMUNICATIONS OF THE ASSOCIATION FOR COMPUTING MACHINERY is published monthly for the Association for Computing Machinery, 5800 N. Marvine St., Philadelphia 41, Pa. Second-Class mail privileges authorized at Philadelphia, Pennsylvania.

In addition to the *Communications*, the Association also publishes the *Journal of the Association for Computing Machinery*. The subscription price for both publications is $5.00 per year for members, of which $3.00 is for the *Journal* and $2.00 for the *Communications*. Subscription to both publications for non-members is $10.00, of which $6.00 is for the *Journal* and $4.00 for the *Communications*. Single copies of *Communications* $1.00.

Subscriptions, notices of address changes and other communications on business matters should be addressed to the Association for Computing Machinery, 2 East 63rd Street, New York 21, N. Y. Material intended for publication and communications on editorial matters should be sent in duplicate to the Editor-in-Chief, or to the Editor of the appropriate department.

By arrangement with the office of Naval Research, U. S. Navy Dept., the Digital Computer Newsletter issued quarterly by that organization is reprinted in its entirety as a supplement to the Communications.

OFFICIAL NOTICES

ANNOUNCEMENT

At its next meeting the Council of the Association for Computing Machinery plans to decide on the site of the National Meeting to be held in 1960. No commitment now exists. This notice constitutes a solicitation of invitations from any interested groups to hold a meeting in their city in 1960. Further information, if desired, can be obtained from the Secretary. Invitations should be directed to the Secretary giving full information about meeting facilities, dormitory and hotel accommodations, possible dates, transportation facilities and any other specific information that is considered relevant.

LETTERS TO THE EDITOR

Dear Editor:

In the April issue of "Communications," you printed a letter discussing names for the computing profession. Here is a suggestion.

In the past few years the word "Computer" has been construed as "Calculator." Also both words have taken on a larger and more encompassing definition than presently defined in Webster's unabridged. I think "Computer" is more universally used in our profession than "Calculator," so I have used computer as the stem for these suggested terms.

From Webster's unabridged, I mention these definitions:

-ology, "A Science"

-ist, "One who practices or is occupied with," therefore I propose:

Comptology—The science of computers, computation, and computer control. Also of computer application. ("Modern" interpretation of "Computers").

Comptologist—A person specializing in "Comptology."

(An elegant sounding definition is:

"A specialist in the systematic mathematical and/or logical solution or simulation of universal problems and systems by the utilization of digital and/or hybrid computers and techniques.")

The word "Comptologist" could then be used with descriptive terms for indicating certain special fields and applications such as the following:

Applied Comptologist
Systems Comptologist
Mathematical Comptologist
Universal Comptologist
Logistics Comptologist
Nuclear Comptologist
Electrical Engineering Comptologist
Applied Systems Comptologist—

and a host of others.

QUENTIN CORRELL
IBM Corp.—Applied Programming
217 West Julian Street
San Jose, California

Dear Editor:

Among the brochures I picked up at the Western Joint Computer Conference was one which advertised a Computer Language Translator for data processing systems. I was at first tempted to assume that this was the answer to our common language problems, but was amazed to find it was a piece of hardware instead of a program. The opening sentence in itself is enough to set the head to reeling—"Can Electro-Data talk to IBM or Univac to Bizmac." Imagine my chagrin when I found out that what was translated was not language but symbols used in constructing a language and indeed only a representation of those. If I were to believe the brochure, I would assume that (because the symbols in which one writes French are the same as the symbols with which one writes English) I can immediately speak French. This I know is not so; therefore, I assume that the brochure is in gross error in choice of terms.

I realize that the ACM has done considerable work in standardizing the meaning of terms used in the computing profession but unfortunately I do not find a definition for "language" in my obsolete Glossary of Programming Terminology. I also realize that the ACM cannot operate like the AMA in the control of malpractice but I do wish it could settle upon certain standards that could be strongly recommended to manufacturers.

Lest it be thought that I am unduly harsh, I am sure the average man in management thinks of "language" as an instruction set for a particular machine. A brochure such as this can well give the mistaken impression that 705 instructions could be machine-converted to Univac for running on the latter machine, whereas I could challenge anyone to do this without creating a larger computer than either of these. Let us be frank about it and say that this device changes "A" into "α," not "THINK" into "ΔYMAN," let alone any translation in meaning of clauses, sentences, paragraphs, etc. Let these people stick to their bailiwick and we who are in the actual profession of creating *computer languages* will stick to ours.

Yours very truly,
OTTO MATTY KHODR
729 Tape Drive
Floating Point, Long Island
New York

Dear Editor:

Much of the computer work done at Lincoln Laboratory is not classified and should be of interest to "Communications" readers. As a sample, I have inclosed a description of the "Lincoln Keyboard"—a new typewriter keyboard designed for use on TX-2 by the Advanced Computer Development Group.

I am sending it via special delivery in hopes that you may try to put it into the June issue. I regret that it comes at such an awkward time.

Please feel free to place it in any department that seems appropriate. (For example the "Letters to the Editor," if you like.) I would certainly be happy to answer any questions that may come up.

Yours truly,
ALEXANDER VANDERBURGH, JR.
Massachusetts Institute of Technology

THE LINCOLN KEYBOARD—A TYPEWRITER KEYBOARD DESIGNED FOR COMPUTERS IMPUT FLEXIBILITY*

A. VANDERBURGH**

A new typewriter keyboard, for direct and punched paper tape computer input will replace the usual commercial keyboard with 88 characters chosen for the convenience of *programmers*. The Lincoln Keyboard is expected to facilitate the programming of algorithmic processes and should allow considerable flexibility in assembly and utility routines.

The 88 characters are incorporated in the 44 key standard typewriter design. The characters chosen for the new keyboard are as follows:

1. Block English Letters	26
2. Standard Arabic Numerals	10
3. Six Greek Letters—$\alpha\ \beta\ \gamma\ \Delta\ \epsilon\ \lambda$	6
4. Twelve Lower-case English Letters—h i j k n p q t w x y z	12
5. Eight Punctuation Symbols—, * ? ′ ( ) { }	8
6. Eleven Formula Symbols—$\Sigma\ \vert\ /\ <\ >\ =\ \equiv\ \cdot\ +\ -\ \times$	11
7. Seven Symbols for Symbolic Logic—$\sim\ \wedge\ \vee$) (◡ ◠	7
8. Eight Special Symbols—○ □ _ ‾ → # ‖ ☛	8
	88

The block letters and arabic numerals are in the standard keyboard locations. All the other symbols are located for maximum convenience. In addition to the standard machine functions (tab, space, backspace, tab set, tab clear) there will be two new ones—superscript shift and subscript shift.

Four of the special symbols (○ □ _ ‾) do not advance the carriage and can therefore be used to enclose, underline, or "bar" the next character typed. The "period" prints in the center of the character space and is perhaps more properly called "dot" (as in "dot" product). The character ☛ will be used to indicate an aside. For example, it can be used to indicate special directions to the assembly program. (It has been nicknamed the "Meta Hand.") The character → is a printed arrow and not a machine function.

The Lincoln Keyboard was designed for use on TX-2, the latest member of a group of experimental computers built at Lincoln Laboratory, M.I.T. It will be used both for preparation of programs on punched paper tape and for direct console communication in program language.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
W	X	Y	Z	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*0*	{	}	<	‖	~	/	>	*
(	)	|	‾	_	○	?	Σ	#	•	,	→	◠	□	◡	☛	′	×	∨	∧	+	−
≡	=	*w*	*ϵ*	Δ	*t*	*y*	)	*i*	(	*a*	*p*	*γ*	*h*	*j*	*k*	λ	*z*	*x*	*β*	*n*	*q*

* The research in this document was supported jointly by the Army, Navy and Air Force under contract with the Massachusetts Institute of Technology.

** Staff member, Lincoln Laboratory, Massachusetts Institute of Technology.

TECHNIQUES DEPARTMENT

Editor's Note:

The following paper is an example of a growing trend in programming today, that of translation from one source language to another so that an existing processor for the second source language can be used without loss of time or development costs. There are many such programs in existence and under development. Some of these are tabulated here for background information. If there are others which have been overlooked, a short description will be received gladly.

SOURCE LANGUAGE	*OUTPUT SOURCE LANGUAGE*
ALGAE (Los Alamos)	FORTRAN
Lockheed Simultaneous Diff. Equations	FORTRAN
VIB (General Motors)	FORTRAN
IT	FORTRAN
XTRAN	FORTRAN (In process, IBM)
FORTRAN	IT
FORTRAN	SOAP (In process, IBM)
IT	SOAP
MATH-MATIC	A-3
FLOWMATIC	C-10, various symbolic assembly languages

Dick Hill, Assistant Director of the Western Data Processing Center at UCLA, offers the following puzzles for a minimum 650 using SOAP language. To be consistent, they should be called Code-Nundrums to match those previously printed for the 704. Answers will be given at the end of this section.

1. The instruction at location B is RAL Y. Location Y is a dump, otherwise unused in the program. Write no more than 4 SOAP instructions to change the data address of the instruction B to Y+1 and cause the changed instruction to be executed, with these restrictions:
   a. Use no preloaded constants.
   b. Do not change the contents of B.
   c. Use no absolute drum location addresses.
   d. Use no store or branch instructions.

2. Write no more than 4 SOAP instructions to test the contents of 8000. If = +1 (00 0000 0001), transfer to location A. If = +2, transfer to location B. It is assumed that the contents will always be one or the other,
   a. Use no instruction containing N in its symbolic operation code.
   b. Use no preloaded constants or absolute drum addresses.

SIMPLE AUTOMATIC CODING SYSTEMS

ELDRIDGE S. ADAMS, JR. AND STEWART I. SCHLESINGER
Aeronutronic Systems, Inc., Glendale, California

INTRODUCTION

In programming any digital computer, there are many routine tasks of a semi-clerical nature. If most of these can be performed by the machine itself, the programmer's task can be simplified, resulting in shorter programming time and fewer errors. When a machine can code itself and produce programs as good or almost as good as a human coder, time and money can be saved through the reduction of error because most of the time consumed in programming is in coding and error elimination.

However, there seems to be a rather firmly established feeling in the digital computing field that automatic coding or translating programs must be complicated to write (involving many man-years of effort)

and must possess a language which in itself is complicated, being different from that usually used by a programmer in his direct coding for the computer. Contrary to these hypotheses, the authors have created a simple but efficient automatic coding system for the IBM 650 with less than one man-year of effort. Further, this system is so simple to use that anyone previously acquainted with the symbolic assembly program (SOAP II) customarily used with the IBM 650 can use the system immediately.**

Some requirements of any coder can be established at the outset. Each step in the process should be readily interpretable by the user. The use of strange symbolism, like letters for mathematical symbols, is to be avoided. In fact symbolic programs are useful precisely because they attempt to use familiar symbolism. In the case of the 650 it is difficult to avoid using artificial symbolism (due to limitations of the 533 Input-Output equipment), but it can be done by proper board wiring. By using the SOAP II format where possible and by fixing the format for equations, this has been possible.*

An important point in the creation of a simple automatic coding system is that it should start as a generalization of a good symbolic assembly program and be primarily designed to *add* formula translation and elementary logical control to the assembly program. The automatic coding system should retain direct programming for its inherent flexibility and simplicity, thus insuring that the coding system will never act as an encumbrance, but simply as an additional aid to the programmer.

Furthermore, one should be able to easily intersperse normal machine or symbolic machine commands so that a series of instructions not easily translatable by the coder can be covered. As a matter of fact, such a feature very nicely supplements the requirement of not providing too many features. This coder has been developed so that coder commands can be interspersed with SOAP II commands while programming. Thus when it is desired to write a special series of commands as a part of a program, they can be written between algebraic expressions, for example, instead of written as a separate program. This flexibility has proven to be very useful.

However, if it is feasible, it is best to avoid a vertical format. Despite the ostensible ease of correction, the errors are easier to find when the expression resembles the normal algebraic form and can be written in a shorter space.

AN AUTOMATIC CODER FOR SOAP II

The Symbolic Optimum Assembly Program (SOAP II) performs some of the desired tasks outlined in the Introduction, such as translation of mnemonic designations for locations and operations to absolute machine language, etc. However, there are several desirable tasks that SOAP II does not perform:

1) Translation of equations to machine commands.
2) Translation of concise logical commands to a succession of test, branch, and advance commands.
3) Generation of entry commands to subroutines.
4) Generation of commands necessary in reading to and punching from non-sequential symbolic locations.

It was felt that these operations could be made into a simple program that would generate the necessary commands. This has proved to be the case. Each of these functions can be fulfilled by the coder as indicated in Table I.

As stated in the Introduction, by keeping the requirements simple, it was relatively easy to write the necessary program. Fortunately some things can be conveniently left out, such as complete loop commands, because the presence of index registers has been assumed, with their inherent simplification of control loops and address modification. This simplifies the coder considerably.

---

* Much of the ingenious wiring of the 533 control panel for the Coder was designed by Mr. Harry Sashkin of the Mathematical Services Department, Aeronutronic Systems, Inc.

** SOAP II Programmer's Reference Manual, Stan Poley, IBM Form 32-7646-1.

TABLE I

TYPES OF STATEMENTS TRANSLATED

Algebraic Statements

Translates algebraic formulas in nearly conventional form with transcendental functions, multiple parentheses, and absolute values. Floating point arithmetic is assumed.

Logical Commands

Commands of the test and advance type. Both the criterion and the increment can be specified.

Subroutine Commands

Enables the writing of the subroutine entry commands in a normal SOAP II format. Since the 650 has a table look-up operation, provision is made for a table look-up with linear interpolation command.

Read and Punch Commands

To produce the necessary series of load, store, and punch or read commands to move data to or from the standard eight field card to any symbolic location.

Example

The mathematical expression: $x=(\sqrt{(B^2-4AC}-B)/2A$

Machine language (SOAP), coded by the authors:

```
RAU  A
FMP  C
FMP  4
STU  TEMP
RAU  B
FMP  8003
FSB  TEMP
LDD          SQRXX
FSB  B
FMP  HALF
FDV  A
STU  X
```

Meaning of Operations Used:

RAU	reset add upper
FMP	floating multiply
STU	store upper
FSB	floating subtract
LDD	load distributor
FDV	floating divide
8003	address of accumulator

Written for the coder:

(		)	op	(		)	op	(		)	op	(		)	op	(		)	op	(		)	op
(	SQRXX			(	B		x		B		–		4		X		A		X		C	)	–
	B	)	/		2		X		A														

This is preceded by an ordinary SOAP card with "ALG" in the operation field and "X" in the data address. This indicates that an algebraic expression follows and that the result is to be placed in symbolic location, "X". A "C" is placed in column 80 of the SOAP and first coder card to indicate a continuous expression on three cards.

As coded by the Coder:

```
RAU B
FMP B
STU TEMP
RSU 4
FMP A
FMP C
FAD TEMP
LDD          SQRXX
FSB B
FDV 2
FDV A
STU X
```

It is seen that the format of the statement prepared for the coder is somewhat fixed but that the symbolism is pretty close to common practice. SQRXX signifies extraction of a square root and is the previously agreed upon symbolic location for the first address of the square root subroutine. "XX" as the last two characters of a symbol indicates an application of a subroutine to the quantity which follows it in an algebraic statement. This symbol convention, while not ideal, is close to the common functional notation. If the user is familiar with SOAP II, he will have little difficulty using the coder. Indeed persons totally unfamiliar with digital computers can read a statement prepared for the coder with very little coaching.

All conventions of the assembly program used for direct symbolic coding are retained. The output of the automatic coding program is precisely the normal format used for direct symbolic coding and can be processed by the normal symbolic assembly program. Also coder statements may be intermixed with programs and subroutines programmed directly in symbolic form.

LOGIC OF THE CODER

The first step in the translation of algebraic formulae is the elimination of parentheses. Each formula is read into the memory in its entirety. The expression is then scanned from the right to the first opening parenthesis. The part of the expression from there to the first closing parenthesis to the right is transferred to a processing portion of memory. The parenthetical expression is replaced by a symbolic address which later may be the temporary storage location of the evaluated parenthetical expression. The transferred parenthetical statement is then translated to SOAP II form. Each parenthesis pair is treated in turn until no parentheses are left. The original expression is then translated in the same manner as a parenthetical expression.

Translation of expressions begins by straightforward generation of the necessary SOAP II commands for evaluation of the first more-than-one-factor term. Then the SOAP II commands necessary to add or subtract all of the one factor terms are generated. Finally the addition (or subtraction) of all of the remaining more-than-one-factor terms is completed.

If a transcendental function occurs within an expression, this is indicated by a five letter symbol ending in XX, such as SINXX or LOGXX.

1) If the transcendental function has a single symbol as an argument, then it is translated before any other translation takes place. But if it has a parenthesis group as an argument, it is translated after the parenthesis has been translated.
2) All functions when translated become the normal calling convention for a subroutine which takes its argument from and places its answer in the accumulator.

Because the 650 cannot read superscripts, a special "power" function is used (for a similar reason, tags are used for indexing instead of subscripts). An example of a power would be the symbol PO4XX, which means raise the expression following it (either a single symbol or a parenthetical expression) to the fourth power. The + and − symbols in the coder stand for operations rather than signs so that a sign control function is used. Sign control is afforded by the following functions:

1) MINXX—take negative of what follows
2) PABXX—take positive absolute value of what follows
3) NABXX—take negative absolute value of what follows.

Both power and sign control functions are translated fully into arithmetic and manipulatory commands and do not involve subroutines. There is nothing unusual or tricky about the detailed programming of the coder for arithmetical expression as well as the other possibilities listed in Table I. Therefore detailed flow diagrams and descriptions will not be given here. It is felt that anyone experienced in programming can make a simple automatic coder based on the foregoing discussion. The routine and wiring diagrams are available on request.

One feature of the logic of algebraic translation that deserves mention is the elimination of redundant load-store commands. Originally the above described logic was used in programming the coder and it was found that frequently a command to store the contents of the accumulator in a symbolic location would be immediately followed by a command loading the accumulator with the same quantity. Since the contents of that symbolic location would never be looked at again, a punched subroutine was incorporated that tests for and avoids such redundancies. Like many simple criteria used in logical programs, this change gave results that are surprising in view of the simplicity of the change. The programs now written by the coder compare very favorably with hand programming.

CONCLUSION

Automatic Coding Systems for digital computers can be thought of as providing two widely divergent functions. First, it can be thought of as a mechanism to enable a novice to utilize a complicated computer. Second, it can provide a competent programmer with the mechanism for shortening his labor with the removal of most of the tedium of coding. The first philosophy has been widely followed elsewhere. It has led to a complicated and rather powerful tool in FORTRAN. In this paper we have described an Automatic Coding System which was predicated on the second philosophy, which leads to a much simpler and more flexible system.

Such a system can be formed for any computer with a small amount of effort. It is desirable (if not essential) to start with a good symbolic assembly program for the computer in question, and for the computer to possess index registers and floating-point arithmetic or an interpretive system to simulate these features. It is then a simple operation to generalize from the assembly program by the addition of algebra translation and some very elementary logic commands to a simple Automatic Coding System. Such a system will naturally retain the important feature of direct programming with the normal language of the symbolic assembly program.

For a small or medium sized computer, it is not a great burden on a potential user to have him learn the fundamentals of symbolic programming, especially since this will be of inestimable value in helping him find the inevitable errors in his program. With potential users so equipped, it is clear that one should follow the second philosophy and develop a simple Automatic Coding System which shares its language with the associated symbolic assembly program, and thus further simplifies the bulk of knowledge to be assimilated by the user. Simple automatic coding systems are quite appropriate for medium-sized machines where the lack of elaborate magnetic tape memory makes a simple system almost mandatory.

Further, even for the large computer, it would be very useful to have a simple Automatic Coding System as a tool of the professional programmer by not forcing him into using the "artificial" language of the more bulky system which was designed for the novice rather than the man who can think in the "language of the computer". It provides him with a method of staying closer to the basic structure of the computer on which he is working, and yet frees him from most of the drudgery of direct symbolic programming. In the case of the large computer, such a simple Automatic Coding System clearly could not supplant such systems as FORTRAN, but it could provide a much needed supplement.

SOLUTIONS—650 SOAP CODE-NUNDRUMS

1.
```
RAL  B
DIV  8001
SLT  0004
ALO  8001  8002
```

2.
```
RAU  8000
SLO  8001
LDD  8002
BD1  B     A
```

NEWS AND NOTICES

NATIONAL ACM

• The June 11, 1958 Council Meeting was attended by President R. W. Hamming and Council Members William F. Aitchison, Franz Alt, Walter F. Bauer, C. V. Bitterli (Proxy for R. P. Rich), John W. Carr, III, Charles Concordia, Jim Douglas, Jr., G. E. Forsythe, Bruce Gilchrist, Saul Gorn, Mandalay Grems, Jack Moshman, James E. Robertson, M. A. Shader (Proxy for C. C. Hurd), J. G. Steward, and J. H. Wegstein. Approximately thirty members of the Association were also in attendance. The items of business included the following:

• After brief presentations by Winston C. Riley, III on behalf of Cleveland petition for Chapter recognition, and Saul Hanges on behalf of the Delaware Valley petition, the Council approved the petitions and Bylaws for both the Cleveland and the Delaware Valley Chapter.

• It was announced that the name of the chapter tentatively known as the Southwest Chapter has been changed to the Rio Grande Chapter and accepted by the Council.

• A discussion was held concerning the proposal of the British Computer Society to make available to ACM members residing in North America their *Journal* and *Bulletin* at $6.00 instead of the standard $9.00 subscription rate. In return they requested a one-third reduction in the subscription price of ACM publication for members of the British Computer Society residing in the United Kingdom and Eire. The President was authorized by the Council to conduct further negotiations with the British Computer Society and establish an agreement on a mutually favorable basis.

• P. C. Hammer presented an invitation to the Association to meet in Madison, Wisconsin, in 1960, probably during the second week in June. The Engineering Institute of the University would be able to handle all physical facilities and requirements. Professor Hammer's request was seconded by representatives of the Milwaukee Chapter. No final decision was taken. The Secretary was requested to place an announcement in the COMMUNICATIONS soliciting any further invitations for a 1960 meeting before the next Council Meeting.

• J. W. Carr, III announced that Senator Wiley of Wisconsin had inserted in the *Congressional Record* various material on computers. In response to a specific request, information about the Association and the computing field was sent by Professor Carr to Senator Wiley.

• The President appointed J. W. Carr, III as the ACM representative to the American Association for the Advancement of Science. An appointment of ACM representative to the National Research Council will be made subsequently.

• A discussion was held regarding the dues period of the Association, specifically as it affected new members joining in the fall or winter. It was decided that the effective date of membership could be selected by the new member as either retroactive through the beginning of the current calendar year or to be effective on January 1st of the following year. There will be no partial-year membership.

• A proposal that the Council take a stand on a suggested Federal Department of Science and Technology with full cabinet rank was referred to W. F. Bauer to secure full information which the ACM Secretary will then circulate.

• A preliminary report on Conference organization and administration was presented by S. Kaplan. This report represents about 35 per cent of the expected total effort. It was the unanimous opinion that such a report would be highly desirable and usable to Local Arrangements Committees, and Mr. Kaplan was commended for his efforts in this area.

• A request was presented by E. C. Berkeley that the Association consider the social responsibilities of computer people to advance socially desirable applications of computers and to help prevent socially undesirable applications. A lively discussion ensued regarding the propriety of the Association investigating such activities. It was decided that the President will appoint a Committee to study the social applications and implications of computing.

• A discussion was held concerning the possible recognition of Users' Groups as organized entities of the Association. In the discussion it was pointed out that many Users' Groups are closely allied with specific manufacturers and that the term "User" might conceivably be broadened to represent groups

having common applicational interests rather than common machines. The President was directed to appoint a Committee of active members of the Association to examine the ways Users' Groups might be recognized as subentities of the ACM and to report back at the next meeting of the Council. The Committee was further directed to examine the constitutional aspects of any recommendations they may present.

• The proposal that an ACM Library be established and maintained either by the Association or through the cooperation of some public or university library was referred to the University Education Committee.

• A. J. Perlis reported that a formal report on the meeting of the Committee on Algebraic Languages in Zurich, Switzerland with representatives of German and Swiss organizations is scheduled to appear in the August issue of the COMMUNICATIONS.

• The issue of financial aid to Local Chapters from the national organization is still under study. The Los Angeles Chapter has requested that at least $1.00 per member per year be provided each local chapter with additional aid available to newly organized chapters. A. W. Jacobson reported that chapter officers have been polled on the desirability of financial and other aid and the relationship of the chapters to the national organization.

• The President was directed to write to all known computer organizations not affiliated with the ACM pointing out the advantages of affiliation with the ACM and inviting such affiliation.

• About 150 copies of the proceedings of the March, 1957 Los Angeles meeting on" New Computers—A Report from the Manufacturers" have been sold to date. The availability of this publication will be further publicized.

• It was announced that the *Journal of the ACM* may publish translations of outstanding Russian papers. It is possible that some additional papers may appear in translation in the COMMUNICATIONS.

• A contract with Mr. Earl J. Sherago was approved whereby Mr. Sherago would be authorized to solicit and sell advertising in the COMMUNICATIONS. It was decided that all house ads for the COMMUNICATIONS should be submitted to the Secretary for approval and subsequent transmission to the Editor of the COMMUNICATIONS.

• At the morning membership meeting a report was received from A. S. Householder on the program for the International Conference on Information Processing. He reported that papers from the U. S. would first be screened by an American Committee but final selection will be made by an International Committee. A six-day meeting is planned. The projected program will cover five areas: (1) Numerical Analysis; (2) Common Languages; (3) Automatic Translation; (4) Storage and Retrieval of Information; and (5) Machine Learning and Pattern Recognition.

ACM CHAPTER NEWS

Syracuse Chapter:

Malcolm Foster reports that at the May meeting of the Syracuse ACM Chapter Mr. Charles Dolfuss, formerly associated with the BULL Company of France and presently a systems engineer for Remington Rand, presented a discussion of the UNIVAC File Computer. The first fall meeting will be held September 24, but no program announcement has been issued yet.

Officers and committee chairmen for the coming year are as follows: President, Robert Jones of Sylvania Electric; 1st Vice President, Rudolph Habermann, Jr., of General Electric; 2nd Vice President, James Stafford of Sylvania Electric; Secretary, Norma Sekinger of Remington Rand; Treasurer, Elizabeth Gruen of Sylvania Electric; Membership Chairman, W. Gutterson, Jr., of IBM; and Publicity Chairman, Malcolm Foster of Sylvania Electric.

Los Angeles Chapter:

At the June meeting of the Los Angeles ACM Chapter the following new officers assumed their duties: Chairman, Don Madden of System Development Corporation; Vice Chairman, Ben Handy of Litton Industries; Secretary, Robert Rector of Space Technology Laboratories; Treasurer, James Tupec of The RAND Corporation. The new chairman for the committees on education, publications, publicity, mem-

bership, and the 4th Day Western Joint Computer Conference Symposium, have not yet been appointed.

The Chapter enthusiastically applauded the announcement that the retiring chairman, Walter Bauer of Space Technology Laboratories, has been elected Southwest Section Officer.

The program for this dinner meeting consisted of a detailed description by Dr. Maurice Halstead of the UNIVAC M-460 ("Countess") computer delivered in May to the Naval Electronics Laboratory in San Diego. (See News Items for a description of the computer.)

St. Louis Chapter:

Dr. L. H. Krone, ACM reporter for the St. Louis office of IBM's Department of Information, reports the new officers of the St. Louis ACM Chapter are as follows: President, W. E. Ball of Monsanto Chemical Company; Vice President, J. L. Egler of Emerson Electric Company; Secretary-Treasurer, C. H. Elliot of McDonnell Aircraft.

UNIVERSITY ACTIVITIES AND EDUCATION PROGRAMS

• The April, 1958, issue reported plans for an IBM 650 installation at Florida State University but didn't include the name of the director: Dr. Robert Des Jardines.

• Correction to the list of IBM 650 installations which appeared in the February, 1958, issue: The director of the center at Washington University, St. Louis, Missouri, is Professor Harvey Cohn.

• A Short Course and Conference on Automation and Computers was held at the College of Engineering of the University of Texas, Austin, Texas, June 2–4, 1958. The meeting was "designed to acquaint and to educate the lay engineer in the computer and automation field since only a small proportion of practicing engineers have training in these areas."

• Indiana University recently installed in its Research Computing Center four tape units, core storage, floating point and indexing accumulators auxiliary to the IBM 650 that has been in operation there since 1956. Mr. Dale Hall has revised the Bell interpretive system to use this equipment.

• Dr. Seymour Parter has been appointed Assistant Director of the Indiana University Research Computing Center and Assistant Professor of Mathematics effective September 1.

• The Department of Industrial Engineering and the University College of Washington University, St. Louis, Missouri, are offering ten courses in Industrial Engineering. "The courses are intended for personnel desiring what is considered to be basic and introductory information in the area of interest. Any industrial engineer, trained as recently as five years ago, would find much new material in these courses since they cover fundamentally the same material presented in the modern industrial engineering undergraduate program.

The courses are: Collective Bargaining for Engineers (8–12 September, $250), Psychology for Engineering (15–19 September, $250), Elements of Integrated and Automatic Data Processing (8-19) September, $450), Engineering Economy (8–19 September, $450), Materials and Processes of Manufacturing (8–12 September, $250), Tool Engineering (15–19 September, $250), Plant Layout and Material Handling (8–19 September, $450), Production Control (8–19 September, $450), Quality Control (8–19 September, $450), and Work Simplification and Measurement (8–19 September, $450). Further information is available from the University College, Washington University, St. Louis 5, Missouri.

• The National Bureau of Standards, conditional upon support by the National Science Foundation, is planning to hold its second Training Program in Numerical Analysis for Senior University Staff. The purpose of this program is to give regular university staff a training in numerical analysis which will enable it to direct the operation of a university computing center, and to organize training and research in numerical analysis on its return to its own institution. The program will occupy the whole of the second semester of the academic year 1958–1959 (February 9–June 5). The number of participants will be limited to twelve; candidates must be citizens of the United States.

The training program will consist of: (a) Introduction to numerical analysis and to programming for automatic computers (2 weeks), (b) Survey of various chapters in numerical analysis and observation of operation of a general purpose computation laboratory (13 weeks), (c) Operation of a computation laboratory (1 week).

Applications must be received not later than October 15, 1958. They should be addressed to Dr. Philip J. Davis, Chief, Numerical Analysis Section, Applied Mathematics Division, National Bureau of Standards, Washington 25, D. C., and should include (1) the academic history of the applicant and a list of his publications, and (2) a statement about the computational program of the institution.

• Director G. N. Lance reported that on May 30, 1958, Professor C. A. Coulson, F.R.S., opened the new computation laboratory at the University of Southampton in England and declared the Pegasus computer functioning. The computer at Southampton University is one of six which are being installed at universities in the United Kingdom, and it is the fourth to become fully operational. The Pegasus, which is manufactured by Ferranti Limited, is being used for university research and is also available for rental usage by local industrial concerns.

• A new Institute for Applied Mathematics was erected at the University of Mainz, Germany. The director is Professor Friedrich Baur, formerly at the Munich Computation Center. The computer laboratory of the institute will be equipped with a digital computer, Zuse Z 22, and an analog computer, Telefunken, both of which will be used primarily for teaching purposes. Research work on formula translation and in numerical analysis will be done in close collaboration with the computation centers of the TH Munich and the ETH Zurich.

• News reports from the Center for Documentation and Communication Research at Western Research University in Cleveland, Ohio, included the following: The WRU Searching Selector is operating continuously on information retrieval pilot searches of various degrees of complexity; information requests to date have been received from members of the American Science for Metals and other groups. Panels have been wired to permit the WRU Searching Selector to perform automatic correlation of fragmentary information. This will permit cluster-type searches.

• The procedures for automatic encoding of telegraphic abstracts for machine searches are being extended to be applicable to languages other than English (e.g., Russian, Japanese, German and French). This is an important step in effecting machine translation of the standardized telegraphic style abstracts from one language to another.

Procedures are also being formulated for automatic recoding of encoded files prepared by other procedures. For example, punched card files prepared by the Patent Offices of the U. S. A. and Australia are being investigated.

• In a survey recently processed on the machines at the Western Data Processing Center, Alpha Kappa Psi, professional business fraternity at UCLA, asked West Los Angeles and Santa Monica stock brokerage houses and small business firms about the characteristics and effects of the "1957" recession. The study produced statistics on opinions regarding the actual date of the recession, the reasons for the sales decline, predictions on future market fluctuations, and types of stock sales during the recession.

NEWS ITEMS

• The ElectroData Division of Burroughs Corporation has announced the development of a punched card input unit for the Burroughs E101. The new unit, used in conjunction with standard card keypunches, permits separate or intermixed data and instructions to be read into the computer from information in punched cards or directly from the keypunch keyboard. Depending upon the keypunch model used, the unit's speed varies between 17 and 20 card columns per second. First deliveries of the device are scheduled for late this year; cost per unit will be $5,500, or $175 monthly rental.

• Rese Engineering, Inc., in Philadelphia (Pennsylvania) has announced the Model 1100 magnetic core tester, a modular type, programmed current pulse generator, designed to deliver fully controlled, high amplitude current pulses for laboratory analysis and production testing of magnetic materials. The 1100 delivers pulse currents up to 2 amperes, with a dynamic range of over 250 volts. Although 50 and 75 volt dynamic ranges are adequate for driving miniature ferrite cores, the additional range provided by the 1100 is required for driving logic blocks, core planes and the larger tape wound metallic cores. Programming is based on an 8 step, periodically repeated pattern, with a maximum step repetition frequency of 50 kc.

• The Data Processing Division of IBM has announced a new collator, the IBM 88, which will oper-

ate at speeds better than 2½ times faster than its predecessors. The new machine will handle card feeding at a rate of 650 per minute from each of two feed devices—one a file feed device and one a conventional card hopper. Major features include non-stop stackers, error detection circuits to guard against double punches and blank columns, and sequence-checking units to enable the performance of identical or completely different operations in each feed at the same time.

• The Lynn Computations Operation staff of General Electric has developed a simulator program for the IBM 650 which makes it possible to process 650 program decks directly on the 704 without modification and with no loss in accuracy. The procedures of the 650, with the exception of timing, are duplicated exactly within the 704. Debugging features incorporated in the program provide for obtaining a trace of the 650 program under control of one of the sense switches of the 704 computer and allow a print out of up to five selected blocks of the drum area when program trouble occurs. Depending upon the makeup of the particular 650 program involved, work can be processed about three times faster on the 704 than on the 650. The simulator program also allows the 704 to be used as a back-up machine to cover the 650 during routine operating difficulties, and it enables 650 computer groups to convert to a larger scale machine without the necessity for reprogramming all existing work. The 650 simulator program is more fully described in a report, R58AGT210, which is available upon request through Harry R. Rymer or Betty R. French, Lynn Computations Operation, General Electric, 950 Western Avenue, West Lynn, Massachusetts.

• More information on the UNIVAC M-460 computer ("Countess"): It is a transistorized solid-state computer, 3′ x 3′ x 6′ in size, with 32,000 words (or 64,000 half-words) of core storage. It utilizes a 30-bit clock which counts milliseconds for real time control. The 400 cycle, 3-phase power usage is 1.2 kw. The core memory consists of 128 x 128 grids. There are no hot filaments in the computer itself, only one in the Ferranti reader. The 30-bit word structure for an instruction is designed as follows: 6-3-3-3-15. Half words are addressable. It has a 30-bit accumulator, a 30-bit Q register, a circular left shift feature with a right shift operation which drops off least significant bits. The computer utilizes approximately 60 instructions, requiring an average of 17 microseconds per instruction. A memory dump requires only ⅔ of a second. On delivery to the Naval Electronics Laboratory, the first model of the M-460 operated five hours after arrival. Its first task: type out "I am here" as a result of information stored in the core memory in St. Paul.

This computer, conceived in the summer of 1956, was designed by January of 1957 and installed in May, 1958. There are seven of these computers now in production, all on contractual order, and they are available only through the Military Systems Division.

• Dr. Eugene Levin has accepted a position as mathematician with The RAND Corporation, Santa Monica, California.

• Dr. Saul Rosen, formerly with Burroughs Corporation, has been appointed Manager, Programming Research and Development for Philco Corporation's TRANSAC computers. In this new position he will be located at the Philco Government and Industrial plant in Philadelphia. Dr. Rosen, author of several magazine articles on mathematics and digital computer applications, is also Managing Editor of the COMMUNICATIONS OF THE ACM.

• The newest addition to the Western Data Processing Center staff is Alice Johansson who will act as receptionist, dispatcher and tape librarian in the 709 installation.

• Donald J. O'Rear, Midwest Regional Manager for Philco Corporation's field sales organization, has been transferred to the west coast as Western Regional Manager at Philco's new Western Development Laboratories in Palo Alto, California. John D. Temoyan of the Dayton (Ohio) office will replace Mr. O'Rear as Regional Manager in Colorado Springs, Colorado.

• Dr. H. P. Flatt, of Rice Institute, has accepted a position as senior research engineer for Atomics International, Inc., Canoga Park, California.

• The appointment of Miss Maureen Kane to staff mathematician in the computing department of the IBM Research Center in Yorktown Heights, New York, was recently announced by Dr. E. R. Piore, Director of Research of International Business Machines Corporation. Miss Kane, co-author of a technical article on symbolic programming soon to be published by the ACM, is programming the 704 and 709 electronic computers and is a programming consultant for the Research Computing Center.

• The recent travels of George Brown, of Western Data Processing Center at UCLA, have included an appearance at an IBM Applied Science conference at Lake Arrowhead, April 15, and attendance at the Arizona State College (Tempe) seminar, "Electronics for Management Control," where he delivered the keynote address on April 29.

• Mr. Richard H. Hill, Assistant Director of the Western Data Processing Center at UCLA, participated in a panel, "The Use of Computers in Small, Low-Cost Personnel Studies," on May 7 for the Personnel Testing Council of Los Angeles.

• Dr. H. M. Lieberstein has accepted a position as design specialist with Convair, San Diego, California.

• Pierre Boulanger, of Brussels, President of the International Cybernetics Society, recently offered an interesting opinion—he said he saw "no reason why at some future time two machines who felt a mutual attraction could not get together and produce likenesses of themselves."

• Allen Kent of the Center for Documentation and Communication Research at Western Research University, Cleveland, Ohio, recently presented a paper on "The Information Center of Tomorrow" at an ASME meeting in Chicago. Mr. Kent is scheduled to attend the Congress on Automation at the University of Madrid, October 13, 1958.

• F. Parker Fowler, IBM Research Assistant at the University of California, has developed a small installation of tabulating equipment into a valuable tool in the School of Business Administration. Mr. Fowler is a former faculty member of the Business School at the University of Colorado, and he is now working on his doctorate at Cal.

• Lloyd Gainey, formerly with the Burroughs Corporation, has joined Philco Corporation's Government and Industrial Division as Manager of TRANSAC Field Service Engineering. He will be responsible for the organization and operation of field support teams that will install and maintain the new TRANSAC computers.

• Dr. David J. Heartinger has joined IBM in St. Louis as an Applied Science Representative.

• Dr. William E. Ball has joined the Applied Mathematics Section of Monsanto Chemical Company.

• New members of the technical staff of the Computation and Data Reduction Center of Space Technology Laboratories include: Myron Curtis from Bowdoin College, Brunswick, Maine; Kermit Klingbail from Computation Laboratory, University of Wisconsin, Madison, Wisconsin; Keith Redner from NACA, Langley Field, Virginia; Fred Swinger from Atomics International, Canoga Park, California; Tom Sanborn from Douglas Aircraft, El Segundo, California; R. B. Tarkington from Service Bureau Corporation, Los Angeles, California; Robert Mosley, Jr. from G. E., Tempe, Arizona, formerly North American Aviation, Downey, California; and George Richman from North American Aviation, Los Angeles, California.

• Professor Robert F. Jackson of the University of Delaware has originated a bridge playing program for the Bendix G-15D computer. The program sorts the cards, makes decisions on the basis of record searches, and rejects any card that is illegally played from an opposing hand. Plays made for competing hands are fed into the computer by code, and the machine makes the proper responses. The next bridge hand to be coded will be the recent contest hand from *Bridge World*, modified to the extent that the small club from south will be exchanged for the jack, thus making it unnecessary to stipulate the opening lead.

• The Center for Documentation and Communication Research (CDCR) of Western Reserve University in Cleveland, Ohio, has announced the publication of the proceedings of a recent conference in a book entitled, *Information Resources—A Challenge to American Science and Industry*, edited by J. H. Shera, A. Kent, and J. W. Perry. The volume describes a meeting held in February and attended by representatives of 134 leading professional associations, government agencies, foundations, industrial organizations and others for the purpose of considering problems encountered in the exploitation of the world's scientific and technical information. The results of the conference included a recommendation for the initiation of a study program to consider needs, financing and methods for the creation of a National Center for the Coordination of Scientific and Technical Information. This publication includes a description of the program plan and contributed papers; it is being distributed by Interscience Publishers; 250 Fifth Avenue, New York 1, New York (Price $5.00).

Interscience Publishers also has available other books on related subjects in this field.

• Proceedings of the 1958 Western Joint Computer Conference will be published in the late fall of 1958 and will be available to non-registrants from the three cosponsoring societies; The Institute of Radio Engineers, The Association for Computing Machinery, and The American Institute of Electrical Engineers. A Proceedings of the 4th Day Symposium on "Small Automatic Computers and Input/Output Equipment," will be published at a later date by the ACM.

• The Provisional International Computation Centre in Rome, established by contract between the United Nations Educational Scientific and Cultural Organization (UNESCO) and the Istituto Nazionale di Alta Matematica (Italy), recently published its first Bulletin. This first issue was mainly devoted to information concerning the Centre itself whose main function is to ensure mutual assistance and international collaboration between existing bodies dealing with computation and information processing, in particular as regards scientific and technological studies. To accomplish this function the P.I.C.C. will use the services of existing centres which are willing to offer such collaboration in carrying out computations of international interest or helping countries which do not have the necessary equipment.

Future editions of the Centre's Bulletin will publish news concerning scientific studies which are being currently carried on or planned by various institutions; progress achieved in programmation methods; technological developments affecting computation and information processing methods; titles and abstracts of important publications; forthcoming meetings, symposia and training courses; available fell lowships; ideas and suggestions relating to the progress of international collaboration; organizationa- questions; and miscellaneous events in the life of computation institutions (appointments, travel of staff members, exchange of personnel between various institutions, etc.).

Inquiries may be made to: Provisional International Computation Centre, Palazzo degli Uffici, Zona dell' E.U.R., Rome, Italy.

• A team of physicists, mathematicians and engineers recently formed the Manhattan Physical Research Group, Inc., an independent research service organization, for consultation, operations research, training programs, and development studies (through to the model stage) in various areas including data processing. Cyrus Adler, a member of ACM, has been elected President. Other key personnel include Gerard G. Harris, Vice President, and David Weisman, Treasurer. Inquiries may be addressed to Research Director, Manhattan Physical Research Group, Inc., 556 West 191st Street, New York 40, New York.

• Litton Industries, Inc., of Beverly Hills, California, recently announced the purchase of Airtron Inc., producer of microwave equipment.

• ElectroData Division of Burroughs Corporation announced a one-month sales peak record, established in May when it sold $8,500,000 in electronic computers. The record included orders for both the Burroughs 205 and 220.

• Bendix Aviation Corporation has established a new computing center in its New York office at 205 East 42nd Street, under the direction of Robert P. Fopeano. The center is equipped with a Bendix G-15.

• The Ramo-Wooldridge Corporation of Los Angeles has been awarded a 13-½ million dollar contract for installation and operation of an automatic data processing system at the Army Electronic Proving Ground, Fort Huachuca, Arizona. The Army contract calls for Ramo-Wooldridge to provide technical assistance and to conduct field testing of automatic data processing systems for operational suitability and acceptance. Ramo-Wooldridge will operate an IBM 709 computer at Fort Huachuca.

• Plans for the separate incorporation of Space Technology Laboratories (STL) were announced June 20 by Dr. Dean E. Wooldridge, President of The Ramo-Wooldridge Corporation. STL, the portion of Ramo-Wooldridge responsible for systems engineering and technical direction of the Air Force Atlas, Titan, and Thor ballistic missile programs, has functioned previously as a separate, autonomous division of the company, but these plans would convert the Laboratories to a subsidiary corporation.

• At the April 15-16, 1958 meeting of the Military Computer Techniques Group, at The RAND Corporation in Santa Monica, California, a Steering Committee was selected for the purpose of establishing a permanent organization to promote interchange of information related to the application of general purpose computers in the U. S. defense effort, particularly the interchange of information which cannot flow through existing channels because of its military classification. The duties of this Steering Committee will include adopting a name for their organization, setting up criteria for membership, adopting

procedural standards, and creating a representative mailing list. Members of this committee are as follows: Mr. Sidney Cashton, Sylvania Electric, Chairman, pro tem; Dr. Ruth M. Davis, David Taylor Model Basin; Mr. J. N. Graham, Air Force Intelligence; Mr. Frank Heath, Westinghouse Electric; Mr. William Hoover, Jet Propulsion Laboratory; Mr. Eugene Jacobs, The RAND Corporation; Mr. John Matousek, System Development Corporation; Dr. Robert Rich, Johns Hopkins University; Mr. Isadore Silberman, Raytheon Manufacturing Company; and Mr. Jack Strong, North American Aviation. The members of the Selection Committee, which established the above Steering Committee, are: Mr. Paul Armer, The RAND Corporation; Dr. Walter Bauer, Space Technology Laboratories (Ramo-Wooldridge); Mr. Robert Bozak, System Development Corporation; Mr. Sidney Cashton, Sylvania Electric; Dr. Ruth Davis, David Taylor Model Basin; Mr. D. L. Dittberner, IBM; Mr. James Morison, Douglas Aircraft Company—Missiles; Mr. R. E. Porter, Boeing Airplane Company; and Mr. F. V. Wagner, North American Aviation.

• The Western Data Processing Center (WDPC) at UCLA has reported the following items:

Prior to the delivery of its 709 computer in August, WDPC will be moved to a new building, probably in early July. Visitors will be welcome; tours may be arranged by contacting the Assistant Director.

During April and May WDPC welcomed as participating institutions: New Mexico Highlands University, Las Vegas, New Mexico represented by Professor Robert T. Tussing; Sacramento State College, Sacramento, California represented by Professor John R. Cox; San Diego State College, San Diego, California represented by Professor C. L. Terrell; and Whittier College, Whittier, California represented by Professor Robert O'Brien.

The seventeenth run of the UCLA Executive Game, Model No. 2, was held in early June. This game, developed by Assistant Professor James R. Jackson of the School of Business Administration and programmed by Kendall R. Wright for their IBM 650 has been described in Discussion Paper Numbers 66, 69 and 70, prepared by the Management Sciences Research Project. A future model of the game will be programmed for the 709; its first demonstration, tentatively planned for closed circuit TV, is scheduled for January 29-30, 1959.

WDPC also reported that fifty representatives of the Army, Navy and Air Force visited the Center in March in line with their study of the application of EDP to missile production.

• Dr. B. Eckmann, Secretary of the International Mathematical Union, has announced that the application of Rumania for membership in the International Mathematical Union (Group II) has been unanimously approved by the voting nations. The membership of Rumania became effective on March 1, 1958.

• Papers are being solicited for the 1959 Western Joint Computer Conference, to be held at the Fairmont Hotel, San Francisco, on March 3–5, 1959. The theme of this conference will be "New Horizons with Computer Technology"; it will include factual papers dealing with the newer applications of computer techniques, such as Information Retrieval, Operation Control, Pattern Analysis, Decision Making, Computer Communications, Learning Concepts, etc. It is also hoped that there will be two sessions of a speculative nature: A "Blue Sky Session" dealing with the extension of computer technology into areas not considered feasible at present, indicating the advantages of such extension, and also the area of research necessary to bring this application into the feasible range; and a "Philosophy and Responsibility of Computers in Society Session" dealing with the philosophic and/or social implications of the widespread application of automatic computer techniques.

Papers for the 1959 WJCC should be prepared based on a 20-minute delivery time. Three copies of the proposed paper should be submitted by October 1st of this year to the following address: Murray L. Lesser, Chairman, Technical Program Committee, IBM Research Laboratory, San Jose, California.

• "Computing Machinery in The Soviet Union Today" was the topic discussed by John W. Carr, III, President of ACM, at a recent meeting of MADCAP (Minnesota Association for Digital Computer Applications and Programming). Four Russian computers were described: the M2, built in 1954 for the purpose of automating the Soviet electric power system; the URAL, built in 1955, a 280 kc binary series-parallel, 36-bit, 17-operation machine capable of handling 75 words per second and using among other things, a perforated film input-output system; the BESM, built in 1954, which has a 200 word per second capacity with photo electric output and will handle 8,000 3-address operations per second (putting it in

a class with the Univac Scientific or the IBM 704); and finally the STRELA, an advanced version of the BESM with extraordinary single instructions, built-in subroutines providing for single-command log, sine, cosine operations and decimal-to-binary and binary-to-decimal conversion. The current production program for the STRELA calls for the construction of 40 machines this year. The emphasis in computer design and construction is on scientific machines rather than on business data processors.

Dr. Carr then described a Russian development which he termed "Operational Programming," a technique for the use of symbolic language in place of flow diagrams for programming. Russia's advanced state in the art of automatic programming is indicated by an extensive automatic language translation program which is apparently far ahead of the similar effort in the United States.

Other interesting comments by Dr. Carr indicated, 1) An impressive number of young people are active in the computer field in Russia where youth has the advantage of relatively easy access to top-level mathematicians and logicians; 2) In the United States it would be desirable to make an effort to bridge the gap that exists between our best mathematicians and logicians on one hand and our computer people on the other; and 3) Effort should be directed toward better acquainting ourselves with Soviet scientific achievements, even if such effort requires that graduate students learn Russian as a matter of course.

• The Research Section and the Industrial Applications Section of the Royal Statistical Society intend to hold a Conference on Mathematical Statistics at the University of St. Andrews, near Edinburgh, Scotland, from August 22–25. The topics will include: aspects of the analysis of variance, non-parametric inference, stochastic aspects of linear and dynamic programming, and foundations of probability in statistics. Information may be obtained by writing St. Andrews Conference, Attn. Miss U. Croker, Royal Statistical Society, 21 Bertinck St., London, W. I., England.

• The Thirty-ninth summer meeting of the Mathematical Association of America will be held at the Massachusetts Institute of Technology, August 25–28, 1958. Dr. Alston S. Householder of Oak Ridge National Laboratory will deliver the seventh series of Earle Raymond Hedrick Lectures on the general topic of "Some Mathematical Problems Arising in Computations and Matrices." Other topics to be discussed include: Mathematical Physics; Probability and Statistics; Numerical Analysis and Computing Machines; Theory of Games and Mathematical Analysis.

• The 1958 summer meeting of the Society for Industrial and Applied Mathematics (SIAM) will be held at the Massachusetts Institute of Technology August 25–27. The sessions are being held in conjunction with the American Mathematical Society and the Mathematical Association of America. Members of the SIAM Program Committee are: Dr. H. M. Gurk of RCA, Dr. B. McMillan of Bell Telephone Laboratories, Inc., and Dr. D. L. Thomsen, Jr., of IBM. Invited lectures by Professor S. H. Crandall of MIT, Dr. I. Gerst of Control Instrument Company, and Dr. H. D. Mills of Princeton University will be featured in addition to contributed papers in the fields of computer theory, network theory, stress analysis, nucleonics, probability theory, communications theory, hydro-dynamics, nerve network theory, mathematical programming, and systems analysis.

• The International Association for Cybernetics is organizing the Second International Congress on Cybernetics in Namur, Belgium, from September 3–10, 1958. The work of the 1956 Congress which was attended by 800 delegates from 22 countries will be continued. The subjects to be dealt with at the Congress will include: Information (information theory, computing machinery, etc.); Automatic Machinery (the application of cybernetics to machines); Automation (the use of automatic machinery in industry and office work); The Economic and Social Effects of Automation; Cybernetics and the Social Sciences; Cybernetics and Biology.

The languages used at the Congress will be French and English. It is expected that the proceedings of the Congress will be published. Entertainment for attendees will include a visit to the 1958 Brussels World's Fair.

• The 5th Annual Symposium on Computers and Data Processing was held July 24-25, 1958 at the Albany Hotel, Denver, Colorado. This symposium, sponsored by the Electronics Division of Denver Research Institute, included sessions on Components, Logic Design, Computer Design and Systems Organization. The following speakers participated: R. H. Baker, R. J. Rieke, G. Wolff, J. J. Seidman, J. R. Cornell, J. R. Logan, F. E. McFarlin, D. B. Netherwood, J. M. McCoy, F. C. MacNair, M. C.

Green, W. C. Carter, E. W. Bivans, C. H. Hoeppner, R. E. Bellman, P. Brock, R. W. Bemer, and E. A. Keller. Panel discussions on logic design and systems organization were led by R. L. Bowman and B. S. Benson, respectively. Abstracts of papers were available at registration. Entertainment plans included a western barbecue dinner, a summer stock theater program, and a mountain tour to historic Central City, a famed mining town. Further information can be obtained from: C. A. Hedberg, Denver Research Institute, University of Denver, Denver 10, Colorado.

• Pennsylvania State University announced a seminar on Scientific and Engineering Computation under the chairmanship of Dr. Mary Lister July 13–25. The program itemized seven sections as follows: Simultaneous Equations, Eigenvalue Problems, Elliptic Partial Differential Equations, Ordinary Differential Equations, Hyperbolic Partial Differential Equations, Parabolic Partial Differential Equations, and Miscellaneous Techniques.

• A seminar on Digital Design of Electrical Equipment was scheduled for July 6–11 at Pennsylvania State University under the chairmanship of Donald T. Laird. The purpose of this seminar was to enable engineers interested in design work to evaluate the potentialities of the computer approach in the field of electrical design. It also provided an opportunity for the exchange of information among those engaged in design work. The program included "Transistion from the Equations to the Computer Program" by Peter Wegner of Pennsylvania State University; "Computer Design of Transformers by Serial Conversion" by L. C. Zuehlsdorff of Westinghouse Electric in Sharon; "Power Transformer Design—Synthesis on the 705 Computer" by Martin Wollock of General Electric in Pittsfield; "Performance Calculations (on the 650 computer with a SOAP II program) for Fractional Horsepower Motors" by J. F. Harris of Emerson Electric Manufacturing Company in St. Louis; and "The Application of Gradient Methods to the Design of Optimum Systems" by R. R. Brown of M.I.T.

• At the Los Angeles Digital Computers Association's June meeting, Dr. Walter F. Bauer, Director of the Computation and Data Reduction Center, Space Technology Laboratories, discussed "Computers in 1970." Dr. Bauer refuted the idea of automatic programming replacing the programmer by predicting that the advancement of the art of computing and the increase in scope of computer application will keep so far ahead of the increased productivity of the machines, that there will actually be an increased need for programmers. He cited an example wherein the present problems of sorting, if solved to the ideal by automatic programming or machine design advances, will be replaced by new challenges such as language translation. He predicted the future programmer will utilize stored programs for "system programming" by the computer. He predicted the "closed shop" will gradually give way to a "pseudo open shop," with computation systems programmers, outnumbering applications programmers, continuing operation on a closed shop basis. He concluded by describing an ideal computer of the future, "Ultradatic," which will be essentially modular in construction and equipped with a degree of introspection sufficient that it can segregate its application and schedule its own operation.

• The International Computer Conference (described in the May issue of the *Communications*) sponsored by the Northwest Computing Association at the University of British Columbia, Vancouver, B. C., May 24 was highly successful. The Northwest Computing Association has been active since the last quarter of 1957. It has approximately 110 dues-paying members who attend regular monthly meetings.

COMING EVENTS

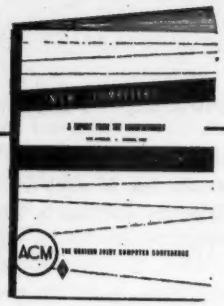
• Conference on Electronic Standards & Measurements
  August 13–15, 1958; National Bureau of Standards Boulder Labs, Boulder, Colorado
  Sponsor: AIEE, IRE, NBS
  Contact: James F. Brockman, Builder Labs, Boulder, Colorado

• International Congress of Mathematicians
  August 14–21, 1958; Edinburgh, Scotland

• WESCON
  August 19–22, 1958; Ambassador Hotel and Pan Pacific Auditorium, Los Angeles, California

- Conference on Mathematical Statistics
  August 22–25, 1958; University of St. Andrews, near Edinburgh, Scotland
  Contact: St. Andrews Conference, Miss N. Crocker, Royal Statistical Society, 21 Bertinck Street, London, W. I., England
- Society for Industrial & Applied Mathematics (SIAM) Meeting
  August 25–27; M.I.T., Cambridge, Massachusetts
  Contact: Dr. D. L. Thomsen, Jr., IBM, 425 Park Avenue, N. Y.
- The Mathematical Association of America—39th Summer Meeting
  August 25–28, 1958; M.I.T. Cambridge, Massachusetts
- American Mathematical Society—63rd Summer Meeting
  August 26–29, 1958; Cambridge, Massachusetts
- International Association for Analog Computation—Second International Conference
  September 1–7, 1958; University Palace, Strasbourg, France
- Second International Congress on Cybernetics
  September 3–10, 1958; Namur, Belgium
  Contact: Secretariat, International Congress on Cybernetics, 13 rue Basse, Marcelle, Namur, Belgium
- SHARE Meeting
  September 10–12, 1958; San Francisco, California
- Meeting on Hydrodynamics
  October 16–18, 1958; Los Alamos Scientific Labs, Los Alamos, New Mexico
  Sponsor: Los Alamos Scientific Labs
  Contact: Dr. G. N. White, Los Alamos Scientific Labs
- 1958 National Simulation Conference
  October 23–25, 1958; Statler-Hilton Hotel, Dallas, Texas
  Sponsors: IRE-PGEC and Dallas Section of IRE
  Contact: J. E. Howard, 2100 Menefee Drive, Arlington, Texas
- American Mathematical Society Meeting
  October 25, 1958; Princeton University, Princeton, New Jersey
- Fifth Annual Computer Applications Symposium
  October 29-30, 1958; Chicago, Illinois
  Sponsor: Armour Research Foundation, Chicago, Illinois
- International Conference on Scientific Information
  November 16–21, 1958; Mayflower Hotel, Washington, D. C.
  Sponsor: National Academy of Sciences, National Research Council, National Science Foundation, American Documentation Institute
  Contact: Secretariat, International Conference on Scientific Information, National Academy of Sciences, 2101 Constitution Avenue, N. W., Washington 25, D. C.
- American Mathematical Society Meetings
  November 21-22, 1958; Pomona, California
  and
  November 28-29, 1958, Northwestern University, Evanston, Illinois
  and
  November 28-29, 1958; Durham, North Carolina
- Eastern Joint Computer Conference
  December 3–5, 1958; Bellevue Stratford Hotel, Philadelphia, Penn.
- American Mathematical Society—65th Annual Meeting
  January 20–22, 1959; University of Pennsylvania, Philadelphia, Penn.
- Western Joint Computer Conference
  March 3–5, 1959; Fairmont Hotel, San Francisco, California
  Contact: M. L. Lesser, IBM Research Lab, San Jose, California

- Joint Meeting of Institute of Mathematical Statistics (Central Region) and the Association for Computing Machinery
  April 2–4, 1959; Case Institute of Technology, Cleveland, Ohio
  Contact for IMS: Martin B. Wilk, Bell Telephone Laboratories, Murray Hill, New Jersey
  Contact for ACM: Daniel Teichroew, National Cash Register, Dayton 9, Ohio
- First International Conference on Information Processing (ICIP)
  June 13–21, 1959; Europe
  Contact for U. S. Committee of ICIP: I. L. Auerbach, Auerbach Electronics Corporation, 109 North Essex, Narberth, Pennsylvania
  Sponsor: UNESCO
- 1959 ACM National Conference
  Summer, 1959; Massachusetts Institute of Technology, Cambridge, Massachusetts
  Contact: F. Verzuh, MIT
- American Mathematical Society Meeting
  Summer, 1959, Salt Lake City, Utah
  November, 1959, Detroit, Michigan
- Eastern Joint Computer Conference
  1959, Boston, Massachusetts



NEW COMPUTERS

. . . A Report from the Manufacturers

Do you know the design and application characteristics of these machines

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BIZMAC II
UNIVAC X-308
STRETCH
PHILCO S-2000
ALWAC 800
IBM 709

?

These nine computer systems—the newest advancements in the art of computing—so new that most of them have not yet been delivered to the customers—are completely described in "New Computers—A Report from the Manufacturers," the proceedings of the March, 1957 technical symposium sponsored by the Los Angeles Chapter of the Association for Computing Machinery.

Copies (8½ x 11, 138 pages) may be ordered from the Association for Computing Machinery, 2 East 63 Street, New York 21, New York. Price $2.50 per copy.

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The purpose of this newsletter is to provide a medium for the interchange among interested persons of information concerning recent developments in various digital computer projects. Distribution is limited to government agencies, contractors, and contributors.

OFFICE OF NAVAL RESEARCH · MATHEMATICAL SCIENCES DIVISION

Vol. 10, No. 3 | Gordon D. Goldstein, Editor, Jean S. Campbell, Asst. Editor | July 1958

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Approved by
The Under Secretary of the Navy
20 August 1957

NAVEXOS P-645

COMPUTERS AND DATA PROCESSORS, NORTH AMERICA

PERCEPTRON — CORNELL AERONAUTICAL LABORATORY, INC. — BUFFALO, N. Y.

The concept of the first non-biological system capable of perceiving, recognizing and identifying its surroundings without any human training or control, has been successfully demonstrated and proven by Dr. Frank Rosenblatt, research psychologist at the Cornell Aeronautical Laboratory, Inc. of Buffalo, N.Y., under contract for the Office of Naval Research, Information Systems Branch, Washington, D.C.

Although the pilot model of a machine designed specifically for these functions is about one year from completion, the "Perceptron" system has been effectively simulated on an IBM 704 computer many times in proving its concept and practicability. It has in each case demonstrated the ability not only to "learn" what it is "shown," but also a capability of spontaneously "teaching itself."

The perceptron will consist of interconnected units, which are capable of responding to appropriate signals, or impulses, and which deliver output signals analogous, in many ways, to nerve impulses. While the basic organization of the perceptron is similar to that of a biological system, certain differences and simplifications should be noted. For one thing, the projection area, which is found in all advanced biological systems, is not essential for the perceptron, although it does serve important functions in some models. In simplified models, the retinal points are assumed to be connected directly to randomly selected units (A-units) in the association system. Second, the responses (R-units) of the perceptron are typically binary devices which are either "on" or "off," or which may sometimes have a third "neutral" condition. At the present time, little attention has been given to responses which must vary in intensity, the R-units of the perceptron being used merely to signal the state of the system. Third, the responses of the perceptron actually combine the functions of the second association layer with those of the motor cortex. The R-units transmit feedback signals to the association system, with some essential constraints which are similar in effect to the constraints in local feedback loops between layers of the association cortex. The feedback connections from an R-unit, like those from the deep cortical cells, return to the same A-units which are responsible for activating the unit in the first place. (In some models alternative constraints are possible, but this rule appears to be one which is most generally satisfactory.)

The responses of the perceptron might best be interpreted as the analog of certain association cells which represent the brain's "recognition response" to particular visual forms, or types of stimuli, rather than the cells in the motor cortex which regulate speech or movement. The activation of a particular response, for the perceptron, might mean, for example, that a triangle is present, or that a man's voice is being heard. Each response is thus capable of representing a particular concept, or abstraction, in terms of which the environment is organized. At the outset, when a perceptron is first exposed to stimuli, the responses which occur will be random, and no meaning can be assigned to them. As time goes on, however, changes which occur in the association system cause individual responses to become more and more specific to particular, well differentiated, classes of forms, such as squares, triangles, clouds, trees, people, etc.

The theoretical bases were well established during 1957, and at that time, the simulation program was started, using the IBM 704 computer, to try to find out how well the theory would hold up in practice. While the 704 could not possibly rival the perceptron in speed and flexibility of performance, it is possible, by examining each connection and A-unit of the system in turn, and computing the appropriate signals which would be transmitted in a physical network, to calculate the performance of a perceptron, in response to a series of visual forms. A large number of such simulation experiments have now been completed, and all main predictions of the theory have been substantiated.

Although there have been many theoretical "brain models" before the perceptron, the main points which set it off from other attempts are:

1. The perceptron is the first system which appears to be economical, in the sense that it can operate successfully, on non-trivial problems, with a smaller number of units than are present in the human nervous system. All previous system designs, which are in any way compatible, are of a completely prohibitive size.

2. The perceptron is not built to rigid logical specifications, in which the failure of a particular unit is likely to cause a breakdown of operation. The design of the system is based on a small number of statistical parameters, and some general logical constraints, but within these limits the actual connections can be drawn from a table of random numbers.

3. The perceptron does not recognize forms by matching them against a stored inventory of similar images, or performing a mathematical analysis of characteristics. The recognition is direct, and essentially instantaneous, since the "memory" is in the form of new pathways through the system, rather than a coded representation of the original stimuli. There is, in fact, no way of reconstructing the original stimuli from the memory, with any absolute certainty. Nonetheless, the probability of obtaining an appropriate recognition response, or "naming response," can be made virtually perfect.

4. As a model for the biological brain, the perceptron does not violate any known information about the central nervous system. Its size, the logic of its connections, the degree of reliability required of individual units, the permissible random variation in its "wiring diagram," and the kinds of signals employed, are all consistent with known anatomical and physiological data. The differences from the nervous system are generally in the direction of simplification, rather than complication, since it is often possible to achieve effects in an electronic model which would require many cells and connections in a biological system. At only one point—the assumed "value" of the A-units—is there an assumption which does not have a clearly identifiable counterpart in the biological brain, and this appears to be due to difficulties of measurement, rather than incompatibility of the concept.

5. The perceptron is the first system which has been proved capable of spontaneous organization and symbolization of its environment, along lines which bear some definite relationship to the human concept of "similarity." While statistical schemes for the correlation and differentiation of patterns have been proposed previously, and might be implemented by a digital computer, the perceptron appears to be the only system which inherently operates in this fashion, as a property of its organization, rather than through the execution of a logical program.

ALWAC III-E — EL-TRONICS, INC. — HAWTHORNE, CALIFORNIA

Since the merger of ALWAC Corporation with El-Tronics, Inc. in March, ALWAC has become the "ALWAC Computer Division, El-Tronics, Inc."

One of the recent installations and computer applications involves the ALWAC III-E which was installed at the Menasco Manufacturing Company, Burbank, California. In addition to the standard accounting and payroll applications, Menasco will employ their III-E for the numerical control of machine tools. A general purpose numerical control routine (NUCOP I and II) has been developed by the ALWAC applications staff. This routine is designed to prepare, from blueprint information, a punched paper tape that will direct a three dimensional numerically controlled milling machine in a continuous path operation through any mathematically definable or approximable surface. The Air Frame Industry has stated that NUCOP represents a significant contribution to the advancement of numerically controlled milling machine techniques.

Recent III-E systems delivered early this year or scheduled for installation within the year include David Taylor Model Basin (Data Reduction); Broadview Research Corporation (Service Bureau and Operations Research) and the Technical Research Group, New York, who will use their system for research projects including nuclear physics, chemistry, and electronics. III-E systems are scheduled for installation at Liggett Drug Co., Connecticut, and Pharmaceuticals, Inc., New Jersey, in the first quarter of 1959. They will be used for inventory control, accounting, and other commercial applications.

The first magnetic tape system for the III-E has been installed at the Personnel Research Board of the Adjutant General's Office, Washington, D. C. The fast (21,000 character per second), buffered (32 word magnetic core) and flexible magnetic system was delivered in February of this year, and was quickly checked out. It is now in productive operation for the voluminous record keeping functions of the PRB. Litton Industries has also recently received and accepted their Magnetic Tape System which will be used with its now extensive III-E for business applications as well as the design problems which have long been associated with the Litton installation. Litton reports that during the month of April, their system has operated a total of 380.8 hours. This represents a remarkable 97.5% of up-time and productive operation.

MANIAC II — LOS ALAMOS SCIENTIFIC LABORATORY — LOS ALAMOS, NEW MEXICO

The MANIAC II, designed and built by the Los Alamos Scientific Laboratory (see Digital Computer Newsletter January 1955), is now in operation with its 12,288 word barrier-grid cathode ray tube memory. Its novel facilities for easy and effective human intervention have already proved valuable.

Work is in progress on a formula coding technique allowing direct entry into the computer of formulae typed on an 84 character Flexowriter. This Flexowriter will be modified for automatic half-line advance and retract, without carriage return, to permit completely general sub and superscripting.

PRINCETON (IAS) COMPUTER — PRINCETON UNIVERSITY — PRINCETON, N. J.

Princeton University (see Digital Computer Newsletter October 1957) will terminate operation of its present computer (formally IAS) by 30 June 1958.

The IAS computer had originally been designed and built by the late John von Neumann and his group at the Institute for Advanced Study. It was the first general purpose stored-program computer and the fastest computer at that time. The IAS computer was copied by several institutions, with slight modifications, and the IBM 701 was largely based on its design.

In July 1957 the IAS computer was taken over by Princeton University after the computer staff had been drastically reduced. The decision to abandon the computer is due to the increasing difficulties in its repair and maintenance, and to the availability of reliable commercial machines. The possibility of exchanging codes between organizations owning one of the widely distributed commercial models has also contributed to Princeton University's decision.

An IBM 650 has been ordered as a temporary replacement but it is felt that Princeton University, together with its various research projects, will soon need a bigger and faster machine presumably an IBM 704.

OFFICE OF RESEARCH AND DEVELOPMENT — U. S. PATENT OFFICE — WASHINGTON, D. C.

Since the middle of May of this year, the Patent Office has been employing the ILAS machine (see Digital Computer Newsletter October 1957) operationally to perform patent searches. Novelty searches of applications for patents directed to polyethylene resins and their methods of synthesis are being performed by ILAS on a group of 246 U. S. patents and 30 foreign patents directed to this field. Future work will expand the search file to include additional foreign patents as well as periodical literature. ILAS permits the asking of questions which have a more complex logic than is possible with conventional card sorting equipment. The search file contains 6,219 cards, which averages about 22 cards per patent. Sorting is at the rate of approximately 500 cards per minute. A complete search, including programming of the machine, requires approximately 22 minutes.

COMPUTING CENTERS

DATA REDUCTION LABORATORY — AIR PROVING GROUND CENTER — EGLIN AFB, FLORIDA

With the merging of the Air Force Armament Center and the Air Proving Ground Command at Eglin Air Force Base, Florida, digital computer facilities have been consolidated under the Data Reduction Laboratory (PGVLD) of the 3208th Test Group (Technical Facilities), Air Proving Ground Center.

An IBM 704 Computer was delivered in March joining the Univac Scientific Model 1103, the Datatron 205, and the IBM 650's in the Laboratory's computer complement.

COMPUTER STUDY — STATE OF MINNESOTA — SAINT PAUL, MINN.

The 1957 Legislature appropriated $50,000 to the Commissioner of Administration for the purpose of conducting a study to determine which administrative activities might be profitably placed under electronic computer operation. It is believed that this is the most comprehensive study of this type undertaken to date by a state government.

The completed study report states that installation by the Minnesota state government of an electronic computer will yield an estimated annual savings of $600,000 to $1,000,000. The study is the first of its kind, covering all operations, ever undertaken by a state government. It grew out of the Minnesota Self-Survey, a comprehensive analysis of all state administrative operations launched in August 1955 by Governor Freeman under direction of Commissioner of Administration Arthur Naftalin.

The report recommends the establishment of an electronic computer center that would initially embrace eight major applications, including:

1. The general statewide accounting function. This is now performed on a decentralized basis by the various state departments. Under the computer program the function would be performed centrally under direction of the State Auditor.

2. Income tax collection. Now partially mechanized, this function would be fully converted to electronic computing, enabling greatly accelerated processing of returns with vastly improved accuracy and more extensive auditing of individual returns.

3. Gasoline tax collection and refunding. While partly mechanized, it is still a burdensome manual operation. Under computer operation the function would be performed more rapidly at reduced cost and with fewer errors.

4. Motor vehicle registration. This function is now in the process of shifting from a wholly manual operation to tabulating machines. It would be further mechanized under the computer program, resulting in a more economical procedure and improved service with fewer errors. It would also provide important statistical and tabulating byproducts and improved reference files which are in constant use. The program would remain under direction of the Secretary of State.

5. Gathering and reporting of welfare statistics. This activity is now performed separately under five reporting systems. Under the computer program, these systems would be integrated into one reporting procedure, thus eliminating duplicate files and consolidating all information pertaining to an individual case in one record.

6. Highway cost accounting. This is now performed on tabulating equipment, but under the computer program it would be accomplished more economically and at greater speed, because the present system, according to the report, requires a multitude of sorting, collating, summarizing and other handling operations, whereas the computer can produce all the required reports in one operation.

7. Payroll preparation. This activity has been the subject of a separate management improvement program which has already resulted in extensive mechanization and partial centralization. Under the computer program the payroll would become fully centralized with greater speed and accuracy.

8. Highway engineering computations. Now partially performed on an electronic calculator of limited capacity, this function under the computer program would be given wider machine application, relieving engineers for essential professional activities, such as designing and research and construction supervision. It is estimated that use of the computer would reduce construction costs by as much as $600 per mile.

The eight functions now require 727 full-time and 348 seasonal employees at an annual salary cost of $3,331,000. With the computer operation they would required 453 full-time and 152 seasonal employees at an annual cost of $2,252,000. The conversion would save 274 full-time and 196 seasonal positions now costing $1,079,000.

The computer would permit abandonment of a number of machine rentals, providing additional savings of $144,647, for a total savings for both personnel and equipment of $1,224,000.

Against these savings, however, must be applied the cost of the computer center itself. This is estimated at $633,751 per year, leaving net annual savings of $590,000.

The computer center would require 38 full-time and 36 seasonal employees for the eight applications, which means that a total of 491 full-time and 188 part-time employees would be needed for operations that now require 727 full-time and 348 seasonal employees.

In addition to these savings, the survey showed that an estimated $271,000 would be saved by extending computer use in highway engineering.

Also, in income tax collection it is conservatively estimated that $141,000 in additional annual revenue for the Income Tax Fund would result because of improved automatic auditing procedures.

The eight functions that would be converted initially represent approximately 60 per cent of the state's data processing load. After these applications have been completely installed, other functions could be readily converted, adding still further savings.

Installation of the computer will require legislative action. This action is planned for 1959.

COMPUTATION LABORATORY — NATIONAL BUREAU OF STANDARDS — WASHINGTON, D. C.

The capacity of the IBM 704 installation at the NBS's Applied Mathematics Division has been augmented by the addition of an 8,000 word magnetic drum. This will facilitate the use of FORTRAN.

TRICE AND MULTIVERTER — PACKARD-BELL COMPUTER CORPORATION — LOS ANGELES, CALIFORNIA

The prototype TRICE system (see Digital Computer Newsletter April 1958) was delivered to the Army Ballistic Missile Agency at Redstone Arsenal in May. This system has generated stable sine waves as high as 8,000 cycles per second in realtime.

An analysis has been made of open form of the Impact Prediction problem using TRICE as a computer. The equations of motion for a 5,000 mile ballistic trajectory can be completely integrated in approximately one second with a step size in range of 1/20 mile. This should give, considering the trajectory solution only, an error in range of approximately one part in 25,000

or 1/5 of a mile. Copies of this report are available, for those interested, by writing V. A. van Praag, Packard-Bell Computer Corporation, 1905 Armacost Avenue, Los Angeles 25, California.

An interesting application of TRICE and MULTIVERTER components has been made in the area of a Realtime Coordinate Conversion. This use is in connection with the new missile tracking equipment which requires digital accuracies and high rates of speeds.

COMPUTATION AND DATA REDUCTION CENTER — RAMO-WOOLDRIDGE CORP. — LOS ANGELES, CALIFORNIA

In January 1958, the former Digital Computing Center of the Ramo-Wooldridge Corporation became the Computation and Data Reduction Center of the Space Technology Laboratories, an autonomous operating division of the Ramo-Wooldridge Corporation. The Center's activities are handled in four major departments: Data Processing and Operations Department, Computer Programming Department, Mathematical Analysis Department, and Data Analysis Department.

In addition to the UNIVAC Scientific Model 1103A Computer and the Epsco ADDAVERTER described in the July 1957 Digital Computer Newsletter, the facilities include an extensive Data Reduction Center as well as an IBM 704 Data Processing System. The 704 went on rental at the Research and Development in Hawthorne, California, on January 6, 1958. This new computer has 8,192 words of core storage and 8,192 words of drum storage. There are 8 magnetic tape units on-line. The extensive peripheral equipment installation includes facilities for off-line card-to-tape, tape-to-card, and tape-to-printer information transfer.

The Center's 704 computer usage has increased steadily since January. During the fourth month of operation (April), productive time totaled 336 hours. Excluding time for preventative maintenance, during April the computer was available 98.1% of the power-on time. The 1103A computer usage remained fairly constant during the first four months of 1958, at an average of 450 hours of productive time per month. Excluding time for preventative maintenance, the computer was available for 95.6% of the power-on time. Three Uniservo tape units now on order for the 1103A computer will soon supplement the existing 7 tape units and will considerably improve the operating efficiency.

RAYDAC — U. S. NAVAL AIR MISSILE TEST CENTER — POINT MUGU, CALIF.

The capabilities of the RAYDAC input system are being further expanded to provide for the processing of digital radar data recorded on magnetic tape. This data can be processed into the computer at rates up to 40 samples per second with the capability of accepting data words either high-order-first or low-order-first. The input system is currently capable of processing paper tape at 200 characters per second, IBM cards at 240 cards per minute, and digital telemetry magnetic tape at rates up to 1000 samples per second.

NAVAL AIR TEST CENTER — U. S. NAVAL AIR STATION — PATUXENT RIVER, MARYLAND

The operating statistics for the Datatron installation at the Naval Air Test Center for the five month period ending 31 March 1958 are as follows:

	Nov. 1957		Dec. 1957		Jan. 1958		Feb. 1958		Mar. 1958	
	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%
Production	159.8	112.1	111.1	74.3	114.7	69.5	73.9	49.3	90.9	63.8
Code Checking	87.6	61.5	16.4	11.0	88.5	53.6	64.2	42.8	59.0	41.4
Idle	1.5	1.1	2.2	1.5	4.0	2.4	0.3	0.2	1.4	1.0
Down Time	4.7	3.3	69.0	46.2	11.2	6.8	16.0	10.7	5.8	4.0
Total	253.6	178.0	198.7	133.0	218.4	132.3	154.4	103.0	157.1	110.3

The first hour of each workday is utilized for preventive maintenance. The remainder of the workday, 7-1/2 hours, is used as the basis for computation of the operating statistics. Percentages in excess of 100 arise when the computer is used for production or code checking after the regular workday. Idle time includes time lost during the basic 7-1/2 hour day due to power failure or air-conditioning malfunction. The large amount of down time during December was the result of primary power equipment failure.

NAVAL ORDNANCE COMPUTATION CENTER — U. S. NAVAL PROVING GROUND — DAHLGREN, VIRGINIA

The 16,000 character per second Charactron printer-plotter (see Digital Computer Newsletter, January 1958) for on-line use with the NORC was delivered and is now undergoing checkout. It is expected to be available for use in June 1958. A Technical Memorandum No. K-13/57, High Speed CRT Printer Programming Manual, has been published for guidance of prospective users.

Construction of the Universal Data Transcriber (UDT) is in progress with a scheduled completion date of January 1959. A contract has been awarded to the Computer Control Company for the 8192 character magnetic core memory to be used in the UDT.

Plans are underway to connect the Computation Laboratory directly, by teletype, to the Vanguard Computing Center and the Naval Research Laboratory in connection with planned increased use of NORC for satellite orbital computations. Programs are now being written and checkout is progressing.

The Computation Laboratory is interested in discussing computational programs for the NORC. The rate for good machine time is $195 per hour. Contact the Director, Computation and Exterior Ballistics Laboratory, U. S. Naval Proving Ground, Dahlgren, Va., Ext. 235.

ELECTRON COMPUTER BRANCH (CODE 280) — BUREAU OF SHIPS — WASHINGTON, D. C.

Bureau of Ships. Calculations of "circular frame strength for submarines" have been performed on the IBM Card 650 in the Bureau.

Applied Mathematics Laboratory, DTMB. Preparations are in progress for the installation of an IBM 704 at the Applied Mathematics Laboratory, David Taylor Model Basin, Carderock, Maryland with turn-over to the Laboratory about August 1. This computer will replace one of the two UNIVAC I's presently installed at the Laboratory. The 704, with 32,000 words of core storage, will be used to further the laboratory's program of scientific computations and to permit greater use of the remaining UNIVAC I for business data processing applications. The 704 will be an interim installation, ultimately to be replaced by the Remington Rand LARC.

AEC COMPUTING AND APPLIED MATHEMATICS CENTER — NEW YORK UNIVERSITY — NEW YORK, NEW YORK

The day shift use of the IBM 704 system at the AEC Computing and Applied Mathematics Center at New York University has rapidly grown in recent months and reached 100% utilization of available time in April. This time is primarily reserved for research problems and is divided between the Center and outside users.

In addition, a second (night) and part or all of a third shift (week-end) is currently being used for production running by contractors of the Naval Reactor Branch of the AEC.

In April, the magnetic core storage capacity of the 704 was increased to 16,384 words. Three additional tape units were installed to bring the total to 12 with 10 units on-line. The new equipment was installed primarily to meet the needs of NRB users, however, by arrangement, it can be used by other groups with access to the machine.

COMPUTERS, OVERSEAS

DATA PROCESSING SYSTEM — THE AUSTRALIAN WEAPONS RESEARCH ESTABLISHMENT — SALISBURY, S. AUSTRALIA

In 1953, the Weapons Research Establishment (WRE) in Australia found it necessary to consider improved methods of data processing to handle the increasing missile trials load and the more stringent demands of the missile contractors.

On analysis it was found that some 70% of the effort in the manual processing of trials information was used in converting the data on various film records into numerical form while the remainder was spent in actual calculation and display of results. It was also noted that data processing could be separated into the distinct phases of data recording, data conversion into digital form, calculation, display, and information assessment.

From these and other similar considerations it has been possible to introduce an automatic digital system at WRE in which all phases of processing have been coordinated and designed to operate at the required speed and precision. Thus some 90% of the data gathered during a trial is now recorded on magnetic tape together with a constant reference frequency on another track. Since most of this data is in the form of frequency, by accumulating the (suitably multiplied) reference frequency for a given number of data cycles one obtains a count proportional to the data frequency. Clearly this count is independent of the original recording or replay speeds so that this form of data recording is suitable for direct automatic digital conversion. The remaining 10% remains on film but is converted semi-automatically into digital form. All digital data is read into an automatic computer which undertakes most of the monitoring, checking, sorting and calculation, thereby reducing processing effort, increasing speed of processing, and transferring most of the standard analysis and assessment from scientific staff.

Generally, one can say that all information from range instrumentation, with the exception of that from theodolites, airborne and high-speed behaviour cameras, is recorded on magnetic tape in such a way that the recording equipment at the range is a minimum and can be operated by remote control. These magnetic tape primary records, if necessary, are changed to digital secondary magnetic tape records by appropriate automatic digitizing converters at WRE. The 3 or 4 types of instruments still providing film primary records are converted by semi-automatic film readers of the BOSCAR and Telereader type into secondary digital records on punched paper tape. These secondary digital records are read by the computer which performs all the necessary checks and calculations and finally displays the results on an output magnetic tape, punched paper tape, or printer, as required. The output magnetic tape is then supplied to a high-speed display unit which gives the necessary graphs and/or tabulations. All the processing equipment such as film readers, automatic converters, etc., have been made as flexible as possible to cope with the records from new or "ad hoc" instruments which may be used in some trials. Similarly, data from other sources may be fed into the computing system at any processing stage, or data may be displayed for supervision without passing through the computer.

It should be noted that the system has been designed to handle the average missile firing rate in one shift operation - peak loads are handled by working extra shifts and weekends. This will be clear from the details of the system described below.

Data Recording

The methods of recording data from theodolites and other telescopic instruments on film are well-known and need not be discussed here.

For the frequency-modulated and time-multiplexed 24-channel telemetry, multi-track magnetic tape is used as the recording medium at a speed of 75 in./sec. On one track of this tape a 100 kc. reference signal is written during the trial, the zero time (or Z.T.P.) being denoted by a 100 microsecond burst of another standard frequency instead of the reference signal. The frequency band of the demodulated signal from each telemetry receiver is recorded on other tracks after the band has been translated to a nominal 30 to 90 kc. The reference signal serves two purposes on playback: after multiplication, it is used for all digitizing

and counting so that wow and flutter effects are insignificant; after dividing down, it provides the elapsed time of observation of the 24 telemetry channels. As part of the normal range facilities this tape can be played back to give a compressed "quick-look" film record or a high-speed frequency-time histogram on 35 mm. film of the 24 channels against time.

For doppler instrumentation, multi-track magnetic tape is used in a similar fashion to that for telemetry. In this case the tape speed is 7.5 in./sec., and the frequency band is either d.c. to 300 cps. or 50 cps. to 3000 cps. The lower frequency band is utilized when the signal is modulated on to a carrier before recording on a track and the higher band is utilized when recording directly. In either case the reference frequency is 10 kc.

The most important factors resulting from the use of magnetic tape have been that any "quick-look" records can be generated after the trial thus reducing the complexity of the receivers particularly in down-range sites, and that the reference frequency recorded in parallel with the range data has made automatic conversion into digital form a relatively simple process.

Data Conversion

Semi-Automatic Film Reading Equipment. The equipment for reading film primary records consists of three BOSCAR's, two Telereader-Telecordex's, and one OSCAR modified to supply 5-hole punched paper tape output in a form directly suitable for input to the digital computer system. All are standard commercial equipment.

Telemetry Converter. This converter was designed and manufactured by WRE to give a digital representation proportional to any frequency lying in the band 30 to 90 kc. by sampling at rates of up to 3 kc. The sampling may be either contiguous or of varying mark-space ratio.

For converting telemetry, the primary record is played back at 7.5 in./sec., or one-tenth recording speed, and the equipment supplies groups of 24 eleven bit numbers to the secondary tape in a format suitable for direct input to the computer system using a tape speed of 100 in./sec., and a packing density of 100 bits/in.

The telemetry conversion relies on the provision of the special synchronizing frequency in the first of the 24 channels. Successive sync frequencies (which may occur at 40 to 140/sec.) are used to provide 24 gating strobes which may be manually set in relation to each other. These strobes gate the data frequency into a counter which is preset to the number of data cycles over which the average frequency is to be determined. While these data cycles are being counted, the multiplied reference frequency (now effectively 3.2 mc.) is accumulated in the reference counter and eventually producing a count inversely proportional to the data frequency. This count is then recorded on the secondary magnetic tape as an 11 bit number, the most significant bit of which is zero while the next ten give the count for frequency. Since the synchronizing frequency is of no further use after separation of the switch cycles, the elapsed time of this channel is accumulated in another and is recorded on the secondary tape in the channel 1 position as an 11 bit number, the most significant bit of which is always unity while the next ten give the time to 600 microseconds. The display on the secondary tape therefore consists of repeated groups of 24 eleven bit numbers, 23 having zero in the most significant position and the elapsed time code having unity in this position. This coding permits the computer to perform the required sorting and monitoring processes on the data. Facilities also exist on the converter for digitizing only portions of the primary record by comparing with preset switches the total elapsed time accumulated from the reference frequency.

The accuracy of conversion varies with the number of data cycles counted, the frequency being digitized, and the noise distribution and level in the data frequency, but is never worse than 1% full-scale and, for normal records, is less than 0.5%. The conversion is usually repeatable to within 0.3%.

Doppler Converter. This equipment was designed and constructed at WRE and uses a conversion process similar to that adopted for the telemetry converter. In this case a preset number of doppler cycles is set up and the time for each group of cycles is provided by counting the multiplied 10 kc. reference signal. This count is recorded as a 13 bit number on magnetic tape as before, and provides both a measure of the frequency, and, by accumulation in the computer,

the elapsed time. Suitable switching arrangements are made between a pair of counters to ensure that the elapsed time is never lost and that overcarries are noted by a special code bit as in the telemetry converter (i.e., 12 bits of elapsed time and 1 code bit).

To ensure that adequate signals are received for counting, a tracking filter with a range of 50 to 3000 cps. is used on the input. In the case of a d.c. to 300 cps. signal, the primary tape is played back at 75 in./sec., or 10 times recording speed, and the carrier frequency removed prior to passing the signal through the tracking filter which then covers the effective range. For a 50 to 3000 cps. input signal, the primary tape is supplied to the converter at 7.5 in./sec. In both cases the output is at 10 kc. on a secondary tape moving at 100 in./sec. A graph of frequency variation with time is also provided independently from the filter for supervisory monitoring.

The accuracy of the converter is such as to ensure that, after inverse interpolation in the computer to provide the number of cycles for equal increments of time, a maximum error of 0.1 cycle is achieved.

Computer

The WREDAC (WRE Digital Automatic Computer) is the computer used in the system and was originally constructed to a WRE specification by Elliott Bros., London, in 1955 as the 403 computer. The present basic features are:

Digit Frequency and Type	333 kc., Single Address, Serial.
Word Length	34 bits or 102 microseconds.
Order Length	17 bits or 2 orders per word.
High-Speed Store	512 words consisting of 127 four word and 4 one word nickel delay lines. The latter are B-lines which are also part of the store.
Backing Store	16,384 words on a magnetic disc rotating at 2,300 rpm. There are 64 tracks of 256 words and each track is accessible for the reading or writing of 64-word blocks.
Auxiliary Store	Three 1/4" magnetic tape units operating at 100 in./sec. with a stop-start time of 10 milliseconds, and a packing density of 100 bits/in. 2,400 foot spools are normally used.
Input	1. Punched 5 hole teletape via 2 high-speed readers at 200 characters/sec. 2. Magnetic tape via the auxiliary store.
Output	1. Punched 5 hole teletape via 2 perforators at 25 characters/sec. (To be replaced by 200 character/sec. punches.) 2. Magnetic tape via the auxiliary store.
Radix Representation	Binary, operating in range -2 to +2.
Instructions	32 arithmetic and logical, 32 transfer (i.e., inter-store and input/output).
Operation Times	Addition, Logical, etc. 102 to 408 microseconds. Multiplication, 1,738 microseconds. Division, 3,468 microseconds. Square Root (Programmed), 7 to 15 milliseconds. Circular Functions (Programmed) 14 to 16 milliseconds.

The machine is now autonomous in that the transfer from, or to, any physically distinct stores or input/output units can occur simultaneously without affecting calculation. Further, the whole high-speed store can be used as a buffer store for 64-word transfers. For the disc store only 64-word transfers can occur. For the magnetic store either single words, 64 whole words, or 129 half words can be transferred to any block of the high-speed store. A word for magnetic tape transfer is greater than 17 bits, a half word is less than 18 bits. Thus the words from the automatic data conversion equipment are always treated as half words in tape transfers.

Three extensions are at present being applied to the WREDAC by means of special orders. These are:

1. "Use B-lines." For the original computer it was thought that 4 B-lines would be sufficient for normal purposes. However, it became obvious that these facilities must be increased so that programming conventions need not be restricted. It is proposed, therefore, to introduce the "Use B-line" order which will allow for further groups of 4 B-lines. Four of the groups will allow each B-line to modify the others in sequence before obeying the order, while the other four will be independent as at present.

2. "Use Logic." The procedure proposed is that, on receipt of the order "Use Logic n," $0<n<16$, the succeeding orders will be obeyed using the machine as if it were a computer operating in the mode of the prescribed logic until the next "Use Logic" order is received. The first two logics will be floating binary arithmetic and character operation with built-in checking. Both of these permit the present store and most of the arithmetic unit to be used. Generally all the extra hardware associated with the logic will be supplied in external cabinets which can be manually switched into or out of the normal computer system.

3. "Use Units." By a similar process to that described in 2 above it is proposed to introduce a transfer order which causes unit n, $0<n<16$, to be used as input/output unit type m, $0<m<8$. This permits groups of two magnetic tape units, teletape readers, or punches to be used simultaneously and does not introduce extensive modifications to the transfer order code. Similarly, facilities will exist for attaching new input/output systems as they are developed.

Output

Low Speed. The input medium used for this type of output is 5-hole teletape. Tabular format obtained by standard teleprinters at 7 characters/second. Graphical display is obtained by means of the low-speed plotting unit. This consists of a 14 row/sec. Lorenz reader, Librascope plotter and relay storage. Up to 8 numbers can be read at a time, any two of which can then be selected as the X and Y coordinates for the plotter. The plotting speed is about 12 points per minute.

High Speed. This unit supplies graphic and/or tabular outputs from the digital magnetic tapes generated within the processing system and consists of a 100 in./sec. magnetic tape unit, line printer, 4 digital plotters, and the electronics and storage necessary to link this equipment. Usually the magnetic tape records consist of repeated blocks of up to 34-bit words in binary form with a space of at least 1 inch between blocks and .08 inches between words. The action of the display unit is as follows:

> The number of words, 1 to 24, to be treated at each stage of output is preset by a switch on the control panel. The types of output, i.e. graphical or tabular, or both, and the number and distribution of words to be supplied to each output unit are also set up independently by selection plugboards on the control panels. When started, the converter reads the required number of words from magnetic tape, transforms them into binary-coded decimal form for printing, and then stores these words in serial registers using a selection plugboard. The selected numbers are then supplied to the output display units, and, when the display is completed, a new block of data is read. The whole process repeats twice a second.

The output equipment consists of a line printer and 4 graphing units. The line printer is manufactured by Bull, Paris, and is used at 2 lines/sec., 92 characters/line. Each of the 92 wheels in the line is set up for printing by the printer selection plugboard from the possible

8 x 24 = 216 tetrads stored during the binary-decimal conversion. The symbols " . ", " * ", " , ", and " % " can be supplied on demand from special pulse emitter sources in the plugboard.

The graphing units consist of 4 modified Mufax 11" facsimile recorders. For plotting purposes the receivers have the following features:

1. The full scale deflection of 11", or 1 helix revolution, is represented by 1,024 counts.

2. Plotting densities of 40 or 20 points/in. are available.

3. A graticule is generated and displayed automatically during operation and is fainter in intensity than the plotted points.

4. Marker points are displayed at the beginning and end of each helix revolution.

5. Either 4 x 2.75 in. graphs or 1 x 11 in. graphs can be plotted on any unit.

6. Numbers to each unit, or to any of the 4 channels of each unit, can be multiplied by 1, 2 or 4.

7. Numbers for plotting must be in the range -1 to +1 or 0 to 1 prior to scaling.

Two points on each of up to 16 graphs can be plotted twice a second and this may be with, or independently of, the printer.

Facilities exist on the control panel for reading every second, third, or fourth block of words from the tape. Using this feature it is possible to decrease the plotting density on the graphing units to 5 points/in. and, since the vertical graticule is generated every 10 points, this means that its dimension can vary from 0.3 x .25 to 0.3 x 2.0 in.

For rapid reproduction of results an Ozalid or Dyline process is used for both graphs and tabulated results.

Operating Statistics, 1956—1958

Parenthetically it is worth noting that all the equipment for the system was delivered and installed by the middle of 1955 but that about 18 months and 30 man-years of effort were required before the automatic system completely replaced the corresponding manual processes. The total elapsed time between a trial and the presentation of final results has been reduced to one-tenth of that required by the manual system, the cost of processing trials information has been reduced by a factor of at least 20. The peak load capacity of the automatic system is about 50 times that of the manual system, and the complete cost of the automatic system has been recovered in the first two years of operation.

Data Recording. No data is available on reliability of the film recording processes, but in the magnetic tape recording procedures however there have been only two failures in obtaining tape records in the past 18 months, and these were due to faulty setting of the reference signals in the first two months of operation. In general it has been found that tape recording is more reliable and can be more precisely processed than the equivalent film records.

Film Reading Equipment. These units have been operating on a single shift of 7 hours per day for the last 18 months and have been effective for 85% of the total time switched on. At least three-quarters of the remaining 15% down-time has been ascribed to electro-mechanical output troubles, particularly in punching of teletape.

Automatic Converters. For single-shift operation of 7 hours per day over the last 18 months these units have been 95% effective. In no case has processing been delayed by any more than 5 hours because of converter malfunction. Most of the 5% down time can be ascribed to malfunction of 12AT7 and 12AU7 valves in binary counting stages.

Digital Computer WREDAC. From July 1956 to March 1957 the computer was switched on for a 5-day 40-hour week. From March 1957 to December 1957 the period was a 5-day 57-hour week, while from December 1957 to March 1958 a 5-day 70-hour week has been used on the average. For these periods the statistics are:

Period	July 1956-Mar. 1957	Mar. 1957-Dec. 1957	Dec. 1957-Mar. 1958
Average Total Time Available/Week	40 hrs.	57 hrs.	70 hrs.
Average Scheduled Maintenance/Week	10 "	10 "	10 "
Average Unscheduled Maintenance/Week	8 "	6 "	8 "
Average Effective Time/Week	20 "	40 "	50 "
Average Standby/Week	2 "	1 "	2 "
Efficiency Factor = $\frac{\text{Effective Time}}{\text{Total Time}}$	50%	70%	72%

Display Units. In the past 12 months these units have been switched on for the same periods as the WREDAC. During this time they have been about 90% effective and in no case has display been delayed for any more than 4 hours. The main cause of down-time has been printer and plotter breakdown.

FINAC-FERRANTI MARK I COMPUTER — ISTITUTO NAZIONALE PER LE APPLICAZIONI DEL CALCOLO — ROME, ITALY

Computer Maintenance. During the second year of operation (June 1956 — June 1957) the total useful time was 2,089 hours and the average weekly efficiency of the computer was 91.2%. Corresponding values for the first year: 912 hours and 89.1 (see Digital Computer Newsletter, January 1957).

The rates of valve replacement and fault time causes are given below in approximate figures and show the corresponding values for each year. One magnetic drum has been replaced after one and a half years of operation.

Type of Valve	Replaced % 1st yr.	2nd yr.
6AL5	5	12
EF55	15	12
EF50	45	40
12AT7	35	40
EF91	35	35
C.R.T.	70	25

Type of Fault	Fault Time % 1st yr.	2nd yr.
Power Supplies	23	1
Valves	17	18
Other Components	3	9
Construct. Failures	3	1
Basic Waveforms	3	12
C.R.T. Store	19	21
Drum	4	18
Input-Output	12	9
Other Causes	5	2
Unidentified	11	3
Parallel Printer	-	6

During the first three quarters of the third year (June 1957 — March 1958) the useful computing time was 1,096 hours and the average efficiency 90.4%.

Scheduled engineering time has been 657 hours, since large modifications have been carried out.

New equipment installed and new order codes. On September 13, 1957 a new Creed Model 25 Perforator was installed. The acceptance test of the perforator consisted in punching about 108,000 characters, which it did with no errors. The average punching speed is about 26.5 characters per sec., with activated check contacts. 7 months experience has shown that the punch is very reliable when properly set. Only occasional adjustments have been necessary.

Before the end of the summer a second Model 25 Perforator and 2 Ferranti 35 mm. Magnetic Tape Units will be installed.

In connection with the installation of the magnetic tape units, new circuits have been added to be used for double precision arithmetic. These two new features are expected to be particularly useful for the solution of large systems of linear equations, especially in cases of ill conditioning.

For double precision operation two orders are used to set or reset a flip-flop. When the flip-flop is in the reset state the computer works as usual, that is, the instructions regarding accumulator and multiplier refer to 40 bits. When the flip-flop is in the set state the same instructions refer to 80 bits.

A "jump if overflow occurred" instruction controls both simple and double precision arithmetic. This allows fixed point operation also in case of ill conditioned systems of linear equations, speeding up computing time.

For the new circuits 106 valves have been installed and 37 removed.

MUSASINO-1 — NIPPON TELEPHONE AND TELEGRAPH PUBLIC CORP. — TOKYO, JAPAN

The first large-scale digital computer with the Japanese invention, "the Parametron," made its debut at the Electrical Communication Laboratory of the Nippon Telephone and Telegraph Public Corporation (the Japanese equivalent of the American Telephone and Telegraph Company) in March 1958. The computer, to be used mainly for scientific purposes, has been designed and constructed by Saburo Muroga with S. Yamada, K. Takashima, and others since 1955.

Operation	Parallel, fixed point, binary 40 bits, single address.
Instructions	Approximately 130.
Speed	Repetition frequency 10 kc, 2.5 milliseconds average for an addition order and 10 milliseconds average for a multiplication order.
Arithmetic Features	Carry detection circuitry and high speed multiplication.
Components	5,356 Parametrons for logical operation and memory selection. 519 vacuum tubes for high frequency source and neon indicators.
Memory	256 words. Ferrite cores with non-rectangular hysteresis. Information is written into and read from cores upon an alternating current principle.
Power	Stabilized dc output of about 5 kw.
Input-Output	6 hole paper tape with odd parity check. Photoelectric reader and teletype equipments.

The Parametrons are driven by a 2.4 mc. high frequency current, modulated by a three-phase low frequency. The repetition frequency of the latter will be modified upward soon to increase the computer's operation speed. Also magnetic drum, magnetic tapes and CRT display will be installed soon.

The computer has many unique features. Because of the expected long life of the Parametrons, there should be little need for component replacement. Therefore the maintenance and operating expenses should be about one third that of a comparable vacuum tube computer with almost no maintenance personnel. After a 10 minute warm up, the computer is always available for computation.

The initial cost of the computer is very low since the Parametron consists simply of a pair of ferrite cores, a capacitor, a resistor, and a coupling core. The computer has worked

very successfully without faults since its completion, because of the high stabilities of the Parametrons and the magnetic memory of cores with non-rectangular hysteresis.

The only difficulties have been bad soldering. After eliminating this problem, there has been no component trouble during the recent few months, and it is expected to be a trouble free computer before long.

G 1, G 1a, G 2, AND G 3 — MAX-PLANCK-INSTITUT FÜR PHYSIK — GÖTTINGEN, GERMANY

All four types of computers have been or are being developed by the Arbeitsgruppe Numerische Rechenmaschinen at Göttingen which forms part of the Max-Planck-Institut für Physik (director Prof. W. Heisenberg), astrophysics division, and are installed at the institute itself. There has been a previous report on the G 1 and the G 2 in the Digital Computer Newsletter July 1955.

The punched tape controlled computer G 1 has operated 33,000 hours to date of which 27,000 have been productive. Because programming of this computer is very simple and easy to learn, G 1 has proved—in spite of its low speed (3 operations/sec.)—to be especially valuable for the younger members of the institute.

G 1a. During this year the G 1 will be replaced by the G 1a, the development of which has just been completed. The trial runs have been successful. G 1a is much faster, larger, and more convenient than the G 1, and is one of the modern paper tape controlled computers. It's specifications are:

Input. Control and input from one of ten photoelectric tape readers, which operate with a maximum speed of 200 characters/sec. and can be stopped at the next character.

Order representation. An order consists normally of 4 characters: one for 24 different operations, two for sector selections on the drum and one for track selector input (see below).

Internal number system. Serial binary, floating point, mantissa 43 bits plus sign, exponent 7 bits plus sign, 1 bit to mark a number.

Storage. Magnetic drum, max. access time 20 milliseconds, capacity 1800 words (30 tracks times 60 sectors) with 3 characters selectable, 40 words with 2 characters selectable, 44 words dead storage for conversion between binary and decimal system at the input and output.

Output. Electric typewriter (10 to 17 characters/sec.), tape punch (50 characters/sec.) with output buffer.

Speed. Average 20 operations/sec. with floating point arithmetic.

Special features of the order code. Arithmetic operations addition, subtraction, multiplication, division, and square root by preorders adjustable to computation with simple or double word length both floating or fixed point. At double word length computation the average speed is reduced only slightly (to 16 operations/sec.).

Transfer orders. Transfer to another tape; transfer to the tape operating before the one carrying the transfer order; conditional skip orders depending on sign mantissa, sign exponent, marked number, and 2 manual switches on the control panel.

Address modifications. In a tape controlled machine they are not impossible, but time consuming. To overcome this difficulty there are two extra features:

1. Cyclical shift shifts the contents of a selectable part of a track on the drum (the part begins with the first sector of the track) one word to the lower address cyclically, e.g. contents of cell numbers 1, 2 ... 23 is restored in cell numbers 23, 1 ... 22.

2. The fourth character of an order (0 to 9) can call up any of the 30 tracks on the drum determined by the settings of the track selector, with 10 independent inputs and 30 outputs controlled by a preorder.

Address modifications are possible by substitution of marked characters from the order tape by figures from the accumulator via the output binary-decimal conversion.

G 1a contains 524 tubes and about 3000 germanium diodes. 3 copies of the machine are almost completed.

G 2. The drum controlled computer G 2 has been in service since 1955. Since the fall of 1956 it has been in operation almost 24 hours per day (including weekends). 3 hours of the day are reserved for maintenance and further improvements of the machine. The total of the productive machine time of the G 2 has been 14,500 hours up to the present. During 1957 G 2 has been in operation 7,900 hours. 95% of the scheduled time (6,800 hours) have been productive. Because the mechanical paper tape reader of the input unit is too slow, it is being replaced by a photoelectric reader of the type used with the G 1a.

G 1 and G 2 applications. The machines G 1 and G 2 are being used exclusively for pure research by members of the scientific staff of the MPI für Physik, of the MPI für Strömungsforschung, and other scientific institutes. The problems dealt with belong to a large number of fields of research, e.g., astronomy and astrophysics (esp. theoretical), cosmic radiation, plasma physics, fluid dynamics and magneto-fluid dynamics, quantum mechanics and field theory and nuclear physics.

G 3. The high speed parallel computer G 3 is still in the state of development. The core memory for 4096 words and the arithmetic unit are completed. This machine will be reported upon in a later issue.

It has been announced that the institute will be transferred to Munich in September 1958.

PROVISIONAL INTERNATIONAL COMPUTATION CENTRE — ROME, ITALY

The Provisional International Computation Centre was established by a bi-lateral agreement concluded in September 1957 between Unesco and the Italian Institute of Higher Mathematics (Instituto Nazionale di Alta Matematica), pending the establishment of an International Computation Centre on a permanent basis. The Provisional Centre has been created for a period of two years but will automatically cease to exist when the intergovernmental Convention establishing an International Computation Centre comes into force.

The Provisional Centre commenced its activities in January 1958. It is located in a modern building on the outskirts of Rome, in the so-called Zona dell'Esposizione Universale a Roma.

The premises available will permit the installation of several machines and will provide adequate staffing facilities when the Centre is fully developed.

The main function of the Centre will be to ensure mutual assistance and international collaboration between existing bodies dealing with computation and information processing, in particular as regards scientific and technological studies. The Centre will promote the exchange of information both on scientific matters and on the facilities existing in various countries. The Centre will also help, on request, the countries which do not possess their own computation equipment. This assistance may consist either in undertaking certain computation tasks with the help of existing services or in giving advice for the creation of national centres. The Centre will also help international organizations which require its assistance. The Centre will promote the training of specialized staff. It will also endeavour to be a link between the users and the designers of computation equipment.

COMPONENTS

ELECTROGRAPHIC RECORDING — BURROUGHS CORP. — DETROIT, MICHIGAN

Burroughs Corporation, Detroit, has announced a production prototype model of a high-speed data recorder that can translate electronic impulses into an immediate plain-language, hard, dry copy. The device can receive messages automatically and assemble into printed characters and words at a speed of 30,000 matrix characters per second. Their technique, labeled "Electrographic Recording," lends itself to producing either matrix or preformed characters. The printing process utilizes a controlled source of electricity to form small charged areas on a high-resistivity surface such as a coated paper. The electrostatic latent image formed by the charged areas is made visible by application of powdered ink, permanently fixed by the application of heat. The recording head comprises 35 tiny wires leading into and through an odd, triangular-shaped piece of plastic. The wires are polished flush with one corner of the "triangle" or printing head, to form a rectangle seven wires high by five wires wide.

72 of these heads in a row form a matrix printing lines. They do not touch the paper but are maintained at a fixed distance from the paper surface. Electric pulses selectively charge all 35 wires or any combination of these in each head.

A normal line of type is made possible by setting up the first character in the line across all 72 heads. The only head that prints is the one selected by a coincident pulse to the back plate, or "anvil." The electrostatic charge can be deposited in one microsecond.

The second character in the word would be set up across the line and printed serially in a similar manner.

The size of the image depends mainly upon the polarity, the electric field strength and the surface coating used on the paper. A relatively low negative voltage applied to the point electrode gives small, round dots.

Features of the technique are:

1. High Speed. A mark can be put on paper in a duration as small as one microsecond and printed characters formed by a five-by-seven dot matrix have been recorded at rates of 1,050,000 dots per second. Plain language messages can be produced at speeds of 300,000 words per minute and more. The only limitation is the speed at which paper can be handled.

2. Highly reliable. By going directly from electronic impulses to static charges on the final usable copy, many intermediate steps are eliminated. This results in a high order of reliability, absence of errors and low maintenance cost.

3. Limited motion. The only mechanical motion involved in the technique is the handling of the continuously moving paper under the printing head. Little wear of the pin electrodes or the like is involved, since they never touch the paper itself but merely send a charge through the paper from the pin to the grounded metal plate (anvil).

4. Inexpensive. The system is basically low in cost and consumes very little power. The power required to print 5,000 characters per second, serially, is about 5 watts in addition to that necessary to move the paper and fix the recorded images. The paper is a little more expensive than ordinary writing paper.

5. Practically noiseless. It is relatively quiet; the only noise is due to the moving paper. No mechanical hammer action is involved.

6. Clean. The printing does not involve any messy, wet or damp processes. An immediate hard, dry, readable copy is obtained on odorless, non-toxic paper.

7. Permanent. Permanent recording with no fading is achieved. By eliminating the inking and fixing steps, the paper can be erased and used over again or can be "read" electronically by picking up the electrostatic charge.

The electrographic ink consists of a single powder without electric charge. To ink the latent image on the paper's surface, the paper is passed through an inker containing the dry powder to give a visible image with virtually no background discoloration. The image is made permanently visible by passing the inked paper over a temperature-controlled hot plate. The three steps in the process are consecutive and are performed as the paper moves at the appropriate speed for the particular recording application.

The high pulsing rates made possible by this printing technique allow reasonably high recording speeds to be obtained in a small-sized, low powered, low-cost recording device. If straight parallel printing is used (line-at-a-time page printer) then phenomenally high speeds are made possible.

Applications for the electrographic recording device can be readily visualized for labeling or strip-printing, digital computer output systems, page-printers and plotters, teletypewriting and telemetering, high-speed strip charting and facsimile. The technique applied to the New York Stock Exchange, for instance, would completely eliminate the "ticker-lag" behind sales on a busy day.

RASTAD — LABORATORY FOR ELECTRONICS, INC. — BOSTON, MASS.

The Computer Products Division of the Laboratory for Electronics, Inc. has been awarded a contract by the U. S. Army Corps of Engineers for a Random Access Storage and Display System, called RASTAD. This RASTAD consists of 3 high density file drums (Model HD-4), nine viewers with 21-inch storage tubes and one symbol generator (viewers and generator Model SM-2), multiplexing equipment, interrogation keyboards for each viewer, and central electronic equipment for tieing RASTAD to an Univac Scientific 1103A Computer.

In this installation, the viewers will display alphanumeric characters and/or map symbols. Each viewer is capable of displaying 12,800 alphanumeric characters or 25,600 map symbols. The file drums will each store 1,600,000 characters. Also, this system may be expanded from the original three to thirty-three drums.

For the first time it will be possible in a large computer system, using random access storage, to query the files without interruption of computer operation.

The LFE HD-File Drums and SM-Generator and Viewers are designed for operation with computers made by other manufacturers where rapid random access to bulk storage, or a rapid readout facility/or both are essential to the effective operation of the system.

SERIES 7000 DIGITAL DATA RECORDER — MINNEAPOLIS-HONEYWELL — BELTSVILLE, MARYLAND

The Davies Laboratories Division of the Minneapolis-Honeywell Regulator Company has in operation at the Beltsville facility a demonstration model of the Series 7000 Digital Data Recorder/Transcriber (DDRT). This system will multiplex all types of low-level transducers such as strain gages, thermocouples, potentiometers, at 10,000 points per second and higher, maintain overall system accuracy within 0.1 percent, staticize to a time resolution of 1/2 microsecond, perform analog-digital conversion to straight binary or BCD code, and arrange preselected information on magnetic tape in a format and record length suitable for computer input.

System reliability, speed, long term stability and accuracy have been proven in operation. Flexibility for modification, ease of maintenance and simplicity of operation are stressed in

the system design. The DDRT is manufactured by Honeywell under agreement with North American Aviation, Inc.

HIGH SPEED ELECTRONIC PRINTER — STANFORD RESEARCH INSTITUTE — MENLO PARK, CALIFORNIA

A new system for high speed electronic printing has been developed at the Stanford Research Institute for the A. B. Dick Company, 5700 West Touhy Avenue, Chicago, Illinois. One embodiment of the system is a facsimile device which reproduces printed documents 8-1/2 x 11 inches at rates up to 3 per second. The documents are scanned in an electro-mechanical scanner and the resulting 4 megacycle video transmitted to a special cathode ray tube. The tube deposits a charge on the surface of ordinary paper by means of fine wires passing through the face plate. The charge pattern is "developed" with a powder and fixed to the paper. Extensive laboratory tests show that the resolution is adequate for the legible reproduction of type as small as that found in telephone directories. The A. B. Dick Company plans to have a prototype system in operation by the end of 1958.

Also under development is a low cost electronic decoder which accepts six parallel wire binary code at the rate of 10,000 characters per second and produces the appropriate video patterns of any of 64 characters and symbols for printout on the facsimile tube. Laboratory equipment for such printout is nearing completion.

The A. B. Dick Company invites inquiries from interested organizations as to the application of these techniques to such problems as high speed computer readout and large scale displays of radar and character information.

MISCELLANEOUS

CONTRIBUTIONS FOR DIGITAL COMPUTER NEWSLETTER

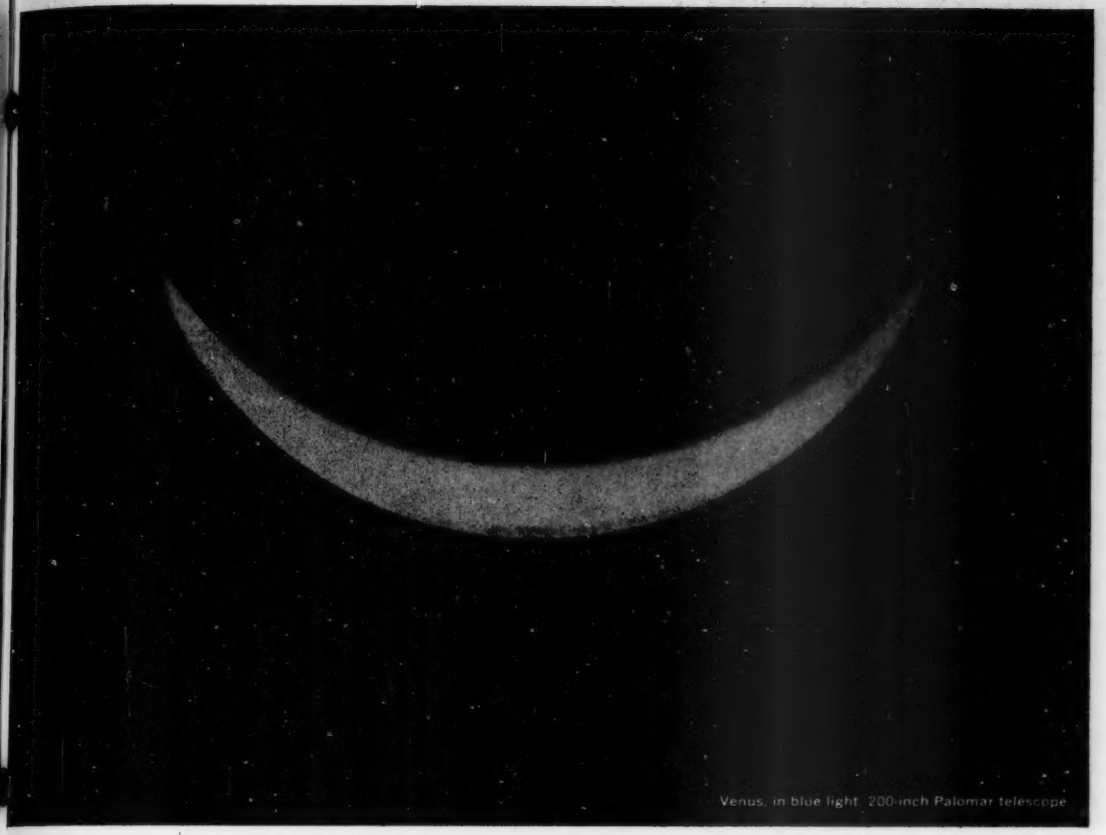
The Office of Naval Research welcomes contributions to the NEWSLETTER. Your contributions will assist in improving the contents of this newsletter, and in making it an even better medium of exchange of information, between government laboratories, academic institutions, and industry. It is hoped that the readers will participate to an even greater extent than in the past in transmitting technical material and suggestions to this Office for future issues. Because of limited time and personnel, it is often impossible for the editor to acknowledge individually all material which has been sent to this Office for publication.

The NEWSLETTER is published four times a year on the first of January, April, July, and October, and material should be in the hands of the editor at least one month before the publication date in order to be included in that issue.

The NEWSLETTER is circulated to all interested military and government agencies, and the contractors of the Federal Government. In addition, it is being reprinted in the Communications of the Association for Computing Machinery.

Correspondence and contributions should be addressed to:

GORDON D. GOLDSTEIN, Editor
Digital Computer Newsletter
Information Systems Branch
Office of Naval Research
Washington 25, D. C.



Venus, in blue light. 200-inch Palomar telescope

SPACE FLIGHT and NUCLEAR PROPULSION

A drastic reduction in vehicle mass ratios... substantially increased specific impulse values... a capability for achieving very high speeds... these are some of the significant advantages that will come from the application of nuclear energy to space flight.

A number of different propulsion systems have been proposed to utilize nuclear reactions. The simplest system consists of a fission reactor through which the propellant is passed, heated, and then expanded through a rocket nozzle. Fission reactors can also be employed as a source of energy to generate electric power, which in turn can be used to accelerate ions or charged particles, or to create and accelerate a plasma. And fusion reactors, when developed, can be used to generate electric power for the same purposes. In addition, in the case of the fusion reactor, there is the attractive possibility that the reaction energy can be used directly without conversion to electric power.

The fission-powered thermal propulsion system will probably constitute one of the next major advances in space technology. As an example of the gain which can be achieved, consider a vehicle with a payload weight of about 25 tons for a manned flight to one of the nearer planets, landing, and returning. Powered by chemical rocket engines, the takeoff weight for such a vehicle would be 50,000 tons. But powered by a fission-thermal propulsion system, weight at launch would not exceed 500 tons... a 100-fold reduction in the mass ratio. Considerably greater gains are predicted for the more advanced systems.

Systems studies and advanced research in the application of nuclear energy to the requirements of space flight are in progress at Space Technology Laboratories. This work illustrates the emphasis at STL on the exploration and development of new concepts and techniques in ballistic missile and space technology.

Both in support of its over-all systems engineering responsibility for the Air Force Ballistic Missile Program, and in anticipation of future system requirements, STL is engaged in a wide variety of analytical and experimental research. Projects are in progress in electronics, aerodynamics, hypersonics, propulsion and structures.

The scope of activity at Space Technology Laboratories requires a staff of unusual technical breadth and competence. Inquiries regarding professional opportunities on the STL Technical Staff are invited.

SPACE TECHNOLOGY LABORATORIES

A Division of The Ramo-Wooldridge Corporation

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ENGINEERS–MATHEMATICIANS

SYLVANIA OPENING NEW DATA PROCESSING LABORATORY IN SUBURBAN BOSTON

"Programmed" staff expansion offers exceptional growth opportunities to engineers and scientists in Digital Computer Activities

If you have the potential to assume increasing technical responsibilities in this field, look into the expanding analysis and development activities at Sylvania's newly formed DATA PROCESSING LABORATORY where Sylvania engineers are engaged in the High Speed Data Processing Phase of the Ballistic Missile Early Warning System – known as BMEWS – in addition to a number of other projects.

Assignments here are of a nature to bring rapid professional growth to the talented and creative man. The environment encourages initiative and original thinking.

Positions are open for:

- SR. DEVELOPMENT ENGINEERS
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- PROJECT ENGINEERS
- SR. LOGICAL DESIGN ENGINEERS
- ENGINEERS WITH EXPERIENCE IN RADAR DATA HANDLING AND DISPLAY

(Previous digital data processing experience is important for most assignments.)

Please send resume in complete confidence to: ERLING MOSTUE

Interview and relocation expenses paid by Sylvania. Inquiries will be answered within 2 weeks. Convenient Saturday interviews arranged.

WALTHAM LABORATORIES Electronic Systems Division

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.

100 First Avenue – Waltham 54, Massachusetts

NOTICES

OF CHANGE OF ADDRESS

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ASSOCIATION FOR COMPUTING MACHINERY

2 East Sixty-Third Street

New York 21, New York.

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One month's notice is required in order to guarantee delivery of periodicals and other mailings to the new address.

PREPRINTS

of the

13th National Meeting of the ACM

containing summaries of most of the papers presented may be purchased from:

ACM Headquarters

2 East 63rd Street

New York 21, New York

Price $3.00

	BENDIX G-15	Computer B	Computer C	Computer D	Computer E
Photoelectric tape reader and tape punch as standard equipment?	yes	no	no	no	no
Punched Card input-output available?	yes	no	yes	no	yes
Auxiliary magnetic-tape storage?	yes	no	yes	no	yes
Operation by self-modifiable internally-stored program?	yes	yes	yes	no	yes
Equipment available for direct input of alphanumeric data?	yes	no	yes	no	yes
Digital differential analyser accessory?	yes	no	no	no	no
Computation proceeds during input and output?	yes	no	no	no	yes
Direct double precision arithmetic with ease of single precision?	yes	no	no	no	no
Arbitrary precision multiplication and division?	yes	no	no	no	no
True minimum access coding?	yes	no	no	no	yes
Block transfer and operation commands for any portion of a channel?	yes	no	no	no	no
Conditional transfer of control after overflow?	yes	no	yes	no	yes
Can break-points be added or removed from commands, at will?	yes	no	no	no	yes
Commands able to operate directly on any memory location?	yes	yes	no	yes	yes

The G-15 and Computers B, C, & D are low-cost machines. Computer E is a leading medium-priced machine.

ONLY THE BENDIX G-15 COMPUTER ANSWERS "YES" TO ALL OF THESE IMPORTANT QUESTIONS

Company after company has asked questions like those above. They've gotten the same decisive answers. Then they have discovered the ease with which the Bendix G-15 General Purpose Digital Computer could be used by their existing staffs, with only brief training...the low initial and operating costs on both purchase and lease plans...and the complete after-sales support for which Bendix is so famous. Aware that today's tough competitive markets will not permit indulgence in inadequate, inefficient, or unjustifiably expensive equipment, these companies have moved quickly. They are our customers.

We're proud of our computer customer list, which bears the names of firms large and small throughout the world. A set of reports on some of their typical applications is available, as well as complete technical data. If you have a specific problem in mind, tell us about that, too. Write to Bendix Computer, Dept. V-1, Los Angeles 45.

Bendix Computer DIVISION OF BENDIX AVIATION CORPORATION

A NEW CHALLENGE IN DATA PROCESSING...

The Astro-Electronic Products Division of the Radio Corporation of America, Princeton, N. J., has immediate opportunities in an advanced and challenging area of automatic data processing. The long-range research program now beginning will involve the solution of logic problems and the programming of deductive rules (non-numeric), and systems engineering.

Technical proficiencies are needed in all branches of data processing, including the following areas of specialization: information systems design, development, analysis and synthesis, programming research and logical design, automatic language-translation and information retrieval, and digital computer design and engineering.

To participate in this program applicants must have advanced technical degrees, or equivalent experience, and a record of achievement. A government security clearance is required of all project personnel.

These opportunities offer stimulating positions in an atmosphere conducive to creative activity. For a personal interview with Mr. M. S. Cohen, Project Manager, call collect or send resume to:

Mr. D. D. Brodhead, Dept. PE-2
Astro-Electronic Products Division
RADIO CORPORATION OF AMERICA
Princeton, N. J.
WAlnut 4-2700

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